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The Iranian Heart Journal

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EDITORIAL

In the Name of God, the Most Beneficent, the Most Merciful

Dear colleagues and friends,

We are delighted to present to you Volume 19, Number 3, 2018 issue of *Iranian Heart Journal*, which contains some interesting new studies and case reports in the domains of cardiovascular medicine and surgery from our colleagues across Iran.

Iranian Heart Journal is indexed in the Scientific Information Database (WWW.SID.IR), IMEMR, Index Copernicus, Scopus, and CINAHL, thereby facilitating access to published literature. There is no doubt, however, that our journal needs your opinions, ideas, and constructive criticism in order to accomplish its main objective of disseminating cutting-edge medical knowledge.

As ever before, we continue to look forward to receiving your latest research and cases.

Yours truly,

A. Hussein Tabatabaei, MD

Editor-in-Chief,
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Original Article

The Kay Mitral Valve Repair in Coronary Artery Disease Concomitant With Ischemic Mitral Regurgitation

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ABSTRACT

Background: Ischemic mitral regurgitation is a major source of morbidity and mortality of myocardial infarction. Surgical intervention for significant ischemic mitral regurgitation at the time of coronary artery bypass grafting (CABG) is controversial and has always presented a great challenge. The purpose of this study was to describe the current surgical options for ischemic mitral incompetency and to discuss when mitral valve repair via the Kay method may be favored over mitral valve replacement.

Methods: Twelve patients candidated for the Kay mitral valve repair plus CABG were recruited. The efficacy of mitral valve repair was echocardiographically recorded at follow-up. To validate the diagnosis of ischemic mitral regurgitation, we conducted a detailed chart review—which included all preoperative cardiac imaging tests at the first, sixth, and 12th postoperative months, as well as the operative records and pathology reports.

Results: Twelve patients (5 male and 7 female) underwent CABG plus the Kay mitral valve repair. All the patients had significant mitral valve incompetency, which was resolved in all of them ($P<0.05$). There was no preoperative or postoperative mortality. No further postoperative mortality was reported at 1 year's follow-up. The Kay technique for mitral valve repair had a desirable result insofar as 8 (72.7%) patients had only mild mitral regurgitation and 4 (33.3%) had mild-to-moderate mitral regurgitation.

Conclusions: In the current era and in Iran, mitral valve repair—especially via the Kay method—has been proven to confer improved short and long-term survival, decreased valve-related morbidity, and enhanced left ventricular function. Future randomized prospective clinical trials are needed to compare this cost-effective surgical technique with its counterparts. ***(Iranian heart Journal 2018; 19(3): 6- 14)***

KEYWORDS: Mitral regurgitation, Coronary artery bypass graft (CABG), Mitral valve repair, Kay method

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Mitral valve incompetency coexisting with coronary artery disease is termed "ischemic mitral regurgitation (IMR)" and is seen in 10% to 25% of patients candidated for coronary artery bypass grafting (CABG). [1-3] Of these patients, 3.4% have severe types of IMR. MR is one of the most common valvular pathologies, and its prevalence has risen in recent years. [4, 5] MR has various mechanisms and etiologies. The classifications of MR which are based on etiologies consist of ischemic and non-ischemic types, while the classifications based on mechanisms comprise functional and non-functional or structural. The Carpentier classification for IMR is an acceptable way the world over for a better understanding of the mechanisms of IMR. In Class I, the mechanism of IMR is only the dilation of the mitral annulus; in Class II, the etiology is the rupture of the papillary muscles and the chordae tendineae; and in Class III, the mechanism is the tethering of the posterior papillary muscles. [6, 7, 12, 13] Despite the consensus among most cardiac surgeons as to the need for intervention for the mitral valve pathology in cases of severe mitral valve incompetency, the clinical presentations of ischemic mitral incompetency in acute and chronic settings are different. Acute mitral valve incompetency, which is usually seen after acute myocardial infarction, has the symptoms and signs of acute heart failure and cardiogenic shock, while subgroups of patients with chronic mitral incompetency in the Carpentier functional Classes II and III have exertional and resting dyspnea. Patients with acute MR usually have pulmonary edema, systemic hypotension, and poor peripheral perfusion. [8] On the other hand, patients with chronic MR suffer from the symptoms and signs of chronic heart failure with variable degrees of chest pain from coexisting coronary artery disease. [8] Transthoracic echocardiography and transesophageal echocardiography are both useful studies for the evaluation of the degree of mitral valve insufficiency and its main mechanism, especially vis-à-vis the size of the annulus and the morphology of the leaflets. The information gained via echocardiography helps assess the feasibility of the repair of the incompetent valve or the replacement of the diseased mitral valve. [6]

When it comes to CABG, there is a great deal of controversy regarding the optimal management of cases with mild-to-moderate IMR. [9, 10] The options in such patients with IMR vary from no intervention on the mitral valve to some types of mitral valve repair and finally mitral valve replacement. [10] Some of the authors who do not believe in the need for intervention in cases with moderate IMR argue that after complete revascularization with CABG alone and the reverse remodeling of the left ventricle, the severity of IMR steadily diminishes. [10]

In light of the abovementioned reports, in the present study, we sought to describe the current surgical options for ischemic mitral incompetency and to discuss when mitral valve repair via the Kay method may be favored over mitral valve replacement repair.

METHODS

Twelve patients who were known cases of coronary artery disease concomitant with significant IMR were recruited in the current study. All the patients were operated on by a single surgical team. After sternotomy and conduit harvesting, the cannulation of the aorta and the cava was performed and cardiopulmonary bypass was initiated. After the insertion of the graft on the desirable and targeted coronary artery, the left atrium was opened. Following the evaluation of the mechanism of MR and the possibility of mitral valve repair, repair via the Kay technique was performed. With the completion of the procedure and the weaning of the patients from cardiopulmonary bypass, intraoperative transesophageal echocardiography was

conducted to confirm the efficacy of the mitral valve repair. Follow-up echocardiography was performed at discharge and thereafter at the third and 12th postoperative months for the assessment of the mitral valve function.

RESULTS

The study population was comprised of 5 male (41.7%) and 7 female (58.7%) patients at an average age of 60.5±8.27 years. The patients' demographic data and risk factors were evaluated. Diabetes mellitus was reported in 5 (41.7%) patients, hypertension in 6 (50%), hyperlipidemia in 9 (75%), and hypothyroidism in 1 (8.3%). A history of smoking was reported in 2 (16.7%) patients and addiction in 1 (8.3%). Nine (75%) patients had a history of myocardial infarction (6 patients with inferior myocardial infarction). The angiographic data showed triple-vessel disease in 11 (91.7%) cases and double-vessel disease in 1 (8.3%). The ejection fraction index was 32.91±8.11% preoperatively and 42.5±7.54% postoperatively (*P*=0.0001). The mean cardiopulmonary bypass time in the Kay repair was 150.25 minutes (± 30.34 min). The mean length of stay at the intensive care unit was 2.50±0.8 days, and the mean length of hospital stay was 6.17±1.89 days. The severity of MR before and after the Kay procedure is depicted in Table 1.

Table 1. Severity of mitral regurgitation before and after the Kay procedure

	Preoperative = 12		Postoperative = 11		*P*
	No.	%	No.	%	
Severity of Mitral Regurgitation					
Mild	0	0%	8	72.7	0.003
Mild to moderate	0	0%	4	33/3	
Moderate to severe	6	50%	0%	0%	
Severe	6	50%	0%	0%	

DISCUSSION

Surgical intervention for significant IMR at the time of CABG is controversial and has always presented great challenges. Different options range from CABG without any intervention on the mitral valve to various types of mitral valve repair and ultimately mitral valve replacement.[10, 11] The etiology of ischemic mitral incompetency can be based on the Carpentier classification with respect to the main cause of the IMR: Type I: normal leaflet motion with annular dilation; Type II: leaflet prolapse with chordal rupture or chordal elongation or papillary muscle rupture or papillary muscle elongation; and Type III: restricted leaflet motion—divided into Type IIIa (during diastole) and Type IIIb (during systole). [12, 13]

The first and foremost question is which cases of IMR concomitant with CABG necessitate mitral valve intervention, however.Aklog et al[14] studied patients suffering from moderate IMR and found that CABG alone could be sufficient in moderate IMR inasmuch as the severity of MR showed a steady decline at follow-up. In other studies on valvular intervention for significant IMR, the results of mitral valve repair were compared with those of mitral valve replacement. In most of these studies, [15-18] for instance that by Al-Radi et al, [15] the results of short- and long-term mitral valve repair were better than those of mitral valve replacement in that the former modality obviated the need for long-time anticoagulation therapy and also conferred a better quality of life. Concomitant intervention for mitral valve incompetency with CABG is associated with a higher mortality rate than with CABG alone. [18] Despite the agreement among almost all cardiac surgeons that mild IMR requires no intervention, in cases of severe IMR, the correction of the incompetent valve is usually necessary. On the other hand, in the subgroup of coronary artery

disease and moderate IMR, controversy abounds. [18] A consensus has yet to emerge as to what constitutes the best management for moderate IMR. At the time of revascularization, some parameters such as long-time survival, the left ventricular ejection fraction index, and the left ventricular diameter for the repair of the mitral valve are of great significance. [19] In patients suffering from IMR, some types of mitral valve repair such as those involving the use of rigid rings, semi-rigid rings, and flexible rings, as well as those entailing the reconstruction of the papillary muscles with new chordae are performed. The advantages of mitral valve repair over mitral valve replacement are clear in that the former modality obviates the need for the long- time use of anticoagulation and confers a better quality of life. However, in some cases of IMR, the cardiac surgeon has options with regard to the repair of the mitral valve depending on the subtype of the IMR and the size of the annulus of the mitral valve. [17-20] In IMR cases in which the main etiology of the regurgitation is the dilation of the mitral annulus, the most common technique for the reduction of the diameter is the use of a designed ring. An increase in the distance between both fibrous trigones in IMR results in the enlargement of the mitral annulus, for which most surgeons prefer rigid or semi-rigid rings. [20] Some cardiac surgeons tend to draw upon the suture annuloplasty technique for the reduction of the mitral valve annulus. Ring annuloplasty is one of these techniques that use non-absorbable suture in both commissural regions to correct the dilation of the mitral valve annulus. In the past, suture annuloplasty was used for the correction of some types of MR in the pediatric group; recently, however, suture annuloplasty in commissural regions has been used successfully for the correction of IMR. [16, 23, 24] In 1963, Kay and Egerton reported on the surgical treatment of 10 patients with ruptured chordae tendineae. Since then, 22 patients—including the aforementioned cases—have undergone surgery for this entity. [23, 24]

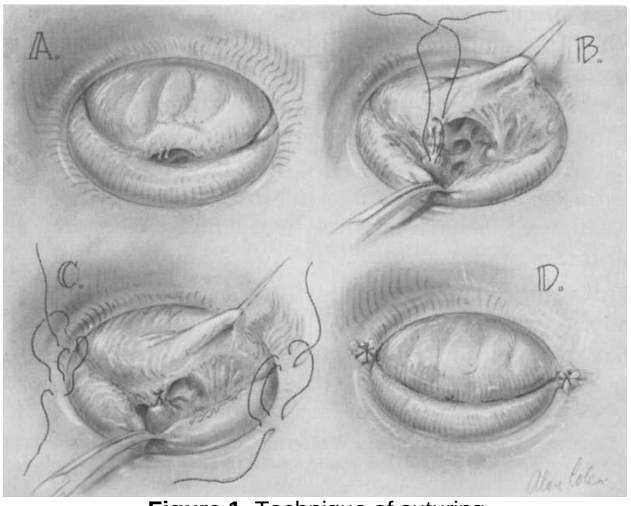

Figure 1. Technique of suturing

The involved area of the valve is sutured down to the nearer papillary muscle with 2 or 3 figure-of-eight sutures of nylon 2-0 (Fig. 1). All the sutures are placed before any of them is tied; otherwise, the papillary muscle is obscured from vision. Good bites of the valve and the papillary muscle are thereafter taken. It should be stressed that new chordae tendineae are not constructed with the sutures; instead, the involved area of the valve with the torn chordae tendineae is sutured to the top of the nearer papillary muscle. The sutures are subsequently tied snugly. This technique is possible because the mural and aortic leaflets are redundant. When the annulus is greatly dilated, a posterior–medial annuloplasty is performed. The annulus of the mural leaflet is decreased without encroaching on the annulus of the aortic leaflet area. Two or 3 figure-of-eight sutures of Ethibond 2 or nylon are placed at this area before tying. The sutures are pulled taut, and if the valve appears competent and the annulus admits 2 fingers, no more sutures are placed and the previously placed sutures are tied. Sometimes, it may be necessary to place sutures at the anterolateral commissure. Again these sutures must be placed to encroach on the annulus of the mural leaflet area and not the annulus of the aortic leaflet area. In repairing the valve, it is necessary not only to correct the tear but also to narrow the annulus. In these

patients, the repair of the valve can usually be accomplished as it can in those patients with annular dilatation unassociated with torn chordae tendineae. [24]

In some of these patients, the severity of valve regurgitation after CABG alone is constant or decreasing, whereas in some other patients without valve intervention at the time of CABG, the degree of MR worsens steadily. [21] Notably, these patients suffer from exertional and resting dyspnea, pulmonary congestion, and edema from mitral valve regurgitation. Ultimately, some of these patients need redo surgery for the repair or the replacement of the regurgitate valve with the risk of the reopening of the sternum in cases of recent CABG with patent grafts at risk of damage. Accordingly, careful and precise management in patients with coronary artery disease concomitant with ischemic mitral incompetency is of vital importance and decision must be made on a case-by-case basis. Moreover, sufficient attention must be paid to several factors like age, the severity of the MR, the presence of acute or chronic MR, and the mechanism and pathophysiology of the MR. There is substantial evidence that patients who have residual significant MR after CABG have lesser survival and quality of life and may, thus, need hospital admission after the primary surgery. [22]

Today, at the time of surgery on patients with IMR, most referral centers believe that for an MR greater than moderate, some type of mitral valve repair should be considered. [19, 26]

Mitral valve reconstructive surgery has been established as the treatment of choice in patients with a favorable anatomy. Long-term follow-up has shown favorable survival rates; low incidence rates of thromboembolism, endocarditis, and neurological events; a low need for mitral valve-related reoperations; and favorable ventricular functions after valve repair by comparison with valve replacement. [25]

No-ring mitral valve repair by shortening the posterior annulus through pericardial strip augmentation to address the lack of leaflet coaptation is a simple reproducible and highly effective technique to restore valve competence in ischemic myocardial infarction. [27, 28]

CABG is most effective in the treatment of functional IMR in patients with viable myocardium (at least 5 viable segments) and the absence of dyssynchrony between the papillary muscles (<60 ms).

Apropos of mitral valve ring annuloplasty, there is a vast array of designs with variations over the theme of complete/partial and rigid/semi-rigid/flexible. Additionally, the 3D shape of rigid and semi-rigid rings is the subject of great variation. A rigid or semi-rigid downsized mitral valve ring annuloplasty is the most advocated treatment in chronic functional IMR of grade 2+ or higher.

As regards CABG combined with mitral valve ring annuloplasty, it should be noted that this procedure can lead to reverse left ventricular remodeling and reduced volumes. Nonetheless, the recurrence rate following CABG combined with mitral valve ring annuloplasty is between 20% and 30% at 2 to 4 years' follow-up. This is also true for studies strictly using downsized mitral valve ring annuloplasty in 2 sizes. A number of preoperative risk factors for the development of recurrent functional IMR have been identified; they include a left ventricular end-diastolic dimension of between 65 and 70 mm, a coaptation depth of greater than 10 mm, an anterior leaflet angle of greater than 27° to 39.5°, a posterior leaflet angle of greater than 45°, and an interpapillary muscle distance of greater than 20 mm.

In regard to CABG alone in comparison with CABG combined with mitral valve ring annuloplasty, the available literature includes 3 randomized studies and a meta-analysis, which indicate that CABG in combination with mitral valve ring annuloplasty has no late survival difference compared with CABG alone, and early mortality might even be higher. Meanwhile, adding mitral valve ring annuloplasty results in a lower New York Heart

Association functional class—most likely as a consequence of a lower incidence rate of persistent or recurrent functional IMR. More randomized studies are underway to further address this topic.

Concerning mitral valve ring annuloplasty in comparison with mitral valve replacement, research shows that the early survival may be higher in the former modality. Nonetheless, the literature is more ambiguous in terms of late survival advantages, with the recent reports having found no late survival advantage from repair over replacement. The recurrence of functional IMR after ring annuloplasty—which was addressed above—was also present in this subset of patients, whereas the incidence of recurrent functional IMR after valve replacement has been scarcely reported. There was an overall tendency of a slightly higher incidence rate of reoperations after ring annuloplasty.

The latest innovation in the design of mitral valve ring annuloplasty includes adjustable rings, allowing the adjustment of septolateral dimensions intra- or postoperatively. Additionally, first in man testing of direct percutaneous catheter-based mitral annuloplasty techniques, both the Alfieri stitch and the minimally invasive MitraClip attach the anterior and posterior leaflets—typically the A2–P2 region—to correct incomplete leaflet coaptation. Patch augmentation of the posterior leaflet in the P2–P3 region increases coaptation in the area most prone to cause functional IMR. Choral cutting of the secondary "strut" chordae releases the anterior leaflet from the tethering due to papillary muscle displacement and improves mitral valve geometry.

Numerous subvalvular approaches to improving the outcome in patients with functional IMR have been introduced; they include very invasive techniques such as surgical ventricular restoration, surgical techniques directly addressing the papillary muscle displacement, and beating-heart procedures with transventricular and epicardial devices applied within a few minutes. The role of transventricular and epicardial devices still remains to be defined, and many of these devices appear to have a hard time gaining a footing in the clinical practice. Meanwhile, the current results with adjunct techniques to CABG and ring annuloplasty such as the papillary muscle approximation technique introduced by Hvass et al and the papillary muscle relocation technique introduced by Kron et al and further developed by Langer et al are gaining continuing support in the surgical community since these techniques can be used with only a little added time but with very good clinical outcomes. [29]

In relation to surgical relocation and papillary muscle sling, research shows improved outcomes in terms of postoperative positive left ventricular remodeling and the recurrence of MR. [30] Still, more investigations are required to confirm the efficacy of subvalvular apparatus surgery. The application of finite element analysis to improve preoperative and intraoperative planning and to achieve a correct and durable repair by means of subvalvular surgery is an exciting new avenue in IMR research. We recently demonstrated in a randomized clinical trial (the Papillary Muscle Approximation Trial) the superiority of papillary muscle approximation in combination with standard restrictive annuloplasty in severe IMR over annuloplasty alone in terms of adverse left ventricular remodeling and MR recurrence.

Papillary muscle displacement is an important element in the pathogenesis of IMR. Preoperative symmetric and asymmetric tethering and isolated inferior wall dyskinesia are an indication for subvalvular apparatus surgery in IMR. [31] Suture annuloplasty can correct ischemia-induced end-systolic distortions in the entire valvular–ventricular complex (ie, inter-leaflet separation, mitral annular dilatation in both axes, and papillary muscle displacement) and abolish acute IMR, independent of any change in the end-systolic

volume. A better understanding of the effects of annular reduction on the papillary muscle geometry may lead to improved subvalvular mitral repair techniques (the Kay method repair). [32]

The Kay method repair is normally achieved by downsizing the mitral valve annulus with suturing and finite element analysis to improve preoperative and intraoperative planning and to achieve a correct and durable repair via subvalvular surgery. [33, 34]

The symmetry of mitral valve tethering and regional left ventricular wall dysfunction have been reported to play a fundamental role in the outcomes and long-term durability of surgical repair in IMR. [34]

CONCLUSIONS

IMR is a complex disorder occurring after myocardial infarction, and it affects both mitral valvular and subvalvular apparatuses. Several abnormalities can be detected in IMR such as annular dilatation, leaflet tethering with impaired coaptation, and papillary muscle displacement along a posterior, apical, or lateral vector. Treatments available include, alongside myocardial revascularization, mitral valve repair or chorda-sparing replacement.

Repair is normally achieved by downsizing the mitral valve annulus with a rigid or semi-rigid ring or suture annuloplasty.

In the current era and in Iran, mitral valve repair—particularly via the Kay method—has been proven to offer improved short- and long-term survival, decreased valve-related morbidity, and augmented left ventricular function. Future randomized prospective clinical trials are needed to compare this cost-effective surgical technique with its counterparts.

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Iranian Heart Journal; 2018; 19 (3)

Original Article

Atelectasis and Related Risk Factors After Congenital Heart Disease Surgery

Hasan Allah Sadeghi[1], MD; Reza Ahmad Pour[2], MD; Akbar Nikpajouh[1], MD; Mohamad Amin Shahrbaf[3]*, MD; Sarina Sadeghi[4], MD

ABSTRACT

Background: Pulmonary morbidity is a common complication of cardiac surgery, and the most common type of morbidity is atelectasis. The risk factors related to pulmonary morbidities and atelectasis have been previously explored in coronary artery bypass graft and valvular surgery. In this study, we sought to determine the risk factors related to atelectasis after adult congenital heart disease surgery (ACHDS).

Methods: This cross-sectional study was conducted on 43 patients (mean=36.3 and SD=16.37) who underwent ACHDS. The risk factors related to atelectasis were identified using a questionnaire which contained demographic factors, types of CHD, underlying diseases, and the length of postoperative stay in bed. The collected data were subsequently analyzed with SPSS.

Results: Of the 43 patients, only 3 (7%) had atelectasis after ACHDS. The tetralogy of Fallot surgery and delayed postoperative ambulation (>24 h) had a *P* value of 0.027 and 0.000, respectively. The other factors had *P* values higher than 0.05 and were, thus, not related to atelectasis.

Conclusions: The tetralogy of Fallot surgery and delayed postoperative ambulation (>24 h) were associated with the rate of atelectasis after ACHDS. ***(Iranian heart Journal 2018; 19(3): 15-19)***

KEYWORDS: Pulmonary atelectasis, Congenital heart defect, Cardiac surgical procedures, Thoracic surgery

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Pulmonary dysfunction was one of the most important complications in the early age of cardiac surgery. [1] Pulmonary complications are common after cardiac surgery and cause some degree of morbidity and mortality. [2, 3] The incidence of pulmonary dysfunction was reported to be 8% with a morbidity rate of 50% and a mortality rate of between 6.6% and 25% in previous studies. [4, 5] These complications consist of atelectasis, pleural effusion, pulmonary embolism, diaphragmatic paralysis, pneumonia, and acute

respiratory distress syndrome. [2, 6] These complications may occur 1 to 7 days after cardiac surgeries such as coronary artery bypass grafting and mitral valve replacement or after cardiopulmonary bypass, and atelectasis is a major problem among them with a maximum rate of 65%. [7-11] These pulmonary complications increase the cost and duration of hospitalization. [12] Congenital heart disease (CHD) is one of the most important issues in cardiology, with a reported prevalence rate of 1/84 in children and 1/245 in adults [13] and a mortality rate of 7.7%. [14] In the present study, we sought to determine the incidence of atelectasis in patients following adult congenital heart disease surgery (ACHDS) and the risk factors related to it.

METHODS

The study protocol was approved by the Research Department and the Ethics Committee of Rajaie Cardiovascular, Medical, and Research Center. A total of 43 patients who underwent ACHDS between June 2015 and November 2015 were recruited and followed up for the rate of atelectasis and the risk factors related to atelectasis following ACHDS. The exclusion criteria comprised canceled ACHDS (regardless of the cause) and emergency surgeries. All hospitalized patients who underwent ACHDS were studied using a questionnaire containing demographic characteristics, underlying diseases, cardiac risk factors, types of surgery, related factors like arrhythmias, length of postoperative stay in bed, and radiological findings. Also explored were the rates of blood or plasma transfusion after infection due to any cause, length of hospital stay, and rates of morbidity and mortality. [15] Atelectasis was confirmed based on the patients' chest X-ray or computerized tomographic scanning, if indicated, in the postoperative period. The collected data were entered into SPSS. For the comparison of the quantitative and qualitative data, the χ^2 test, the exact Fisher test, and the *t*-test or the Wilcoxon–Mann Whitney test were employed. A *P* value of equal to or less than 0.05 was considered statistically significant. Computer codes were used instead of the patients' names in order to observe ethical codes.

RESULTS

Age and Gender

In total, 43 patients who underwent ACHDS with any underlying factors were evaluated. From this total, 22 (51.16%) patients were female and 21 (48.84%) male. The mean age of the study population was 36.3 years (SD=16.37 y), and the minimum and maximum age of the patients was 16 and 67 years, respectively. The study patients were divided into 2 groups: those aged below 36 years (n=12 [27.91%]) and those aged above 36 years (n=31 [72.09%]).

History of Disease and Tobacco Use

From the 43 patients, 13 (30.2%) had a familial history of CHD, 10 (23.2%) had hypertension, 3 (7%) had diabetes, 3 (7%) were tobacco users (the highest rate of consumption=0.5 pack per day), and 7 (16.3%) had a history of heart disease.

Ejection Fraction

The patients' ejection fraction, obtained via echocardiography, ranged between 25% and 55% (mean=31% and SD=16.9%). The ejection fraction was below 31% in 31 (72%) patients.

Types of Surgery

The most common type of surgery among the patients was the closure of atrial septal defects (n=29 [67.4%]) and ventricular septal defects (n=13 [30.2%]). The other types of cardiac surgery were the patent foramen ovale closure (n=2 [4.7%]), the tetralogy of Fallot correction (n=4 [9.3%]), the patent ductus arteriosus closure (n=2 [4.7%]), and the transposition of the great arteries correction (n=2 [4.7%]). Four (9.3%) of these patients had both types of

surgery and 1 (2.32%) had the closure of both ventricular septal defect and patent ductus arteriosus.

Receiving Blood Products

From the 43 patients, 5 (11.6%) received packed cells at an average of 2 units and 4 (9.3%) received fresh frozen plasma at a mean of 3 units.

Prolonged Length of Stay in Bed

Only 2 (4.7%) patients from the 43 patients were out of bed 24 hours after surgery.

Rate of Mortality

Only 2 (4.7%) of the 43 patients died following ACHDS. The other patients (95.3%) were alive at the time of hospital discharge.

Rate of Atelectasis

Atelectasis was detected in 3 (7%) patients from the total of 43 patients after ACHDS.

DISCUSSION

Table 1 depicts the results of our statistical analyses on the study variables. Our results demonstrated that the 2 variables of the tetralogy of Fallot correction and delayed postoperative ambulation (>24 h) had a statistically significant association with the occurrence of atelectasis (P<0.05). Our comparisons of the mortality rate between the patients with atelectasis and those without it showed that one of the patients who died had atelectasis, and this morbidity had a significant statistical relationship with mortality after ACDHS (P<0.05). This finding should, however, be interpreted by taking into account the limited number of patients in the current study.

Some studies with the aid of computed tomography scanning have demonstrated that general anesthesia, which may be seen in almost all types of surgery, is responsible for pulmonary complications and hypoxia due to pulmonary shunting. [16-18] Among our 43 study patients, only 3 (7%) had atelectasis after ACHDS. The rate of atelectasis following cardiac surgery was reported to be 65% in a study. [11] The difference in our findings may be due to the number of patients recruited in our respective investigations and the fact that our statistical population was small. ACHDS is often done on patients with no other organ limitations, and these patients may be compromised due to older age and other comorbidities. There are several studies which have reported pulmonary morbidities after cardiac surgery. [1, 4, 5, 7-9] We, however, explored this complication in the field of ACHDS. Patients' health status, types of anesthesia, types of cardiac surgery, patients' age, the body mass index, hypertension, smoking history, the duration of surgery, and underlying diseases such as diabetes and chronic obstructive pulmonary disease may have an impact on the incidence of postoperative pulmonary complications. [5, 19-22] Concerning ACHDS, we found that the type of surgery and delayed postoperative ambulation might be related to the rate of postoperative atelectasis.

Our findings also indicated the impact of age and underlying diseases such as diabetes and pulmonary disease, which have been previously reported as well. [20-22] We, nevertheless, found no correlation with these factors in our study.

Table 1. Results of the statistical analysis of the variables

Variable		Atelectasis		*P*
		Yes	No	
Gender	Male	2	19	0.489
	Female	1	21	
Atrial septal defect	No	1	13	0.976
	Yes	2	27	
Ventricular septal defect (VSD)	No	2	28	0.903
	Yes	1	12	
Patent foramen ovale	No	3	38	0.692
	Yes	0	2	
Tetralogy of Fallot	No	1	38	**0.000**
	Yes	2	2	
Patent ductus arteriosus (PDA)	No	3	38	0.692
	Yes	0	2	
Transposition of the great arteries	No	3	38	0.692
	Yes	0	2	
Atrioventricular septal defect	No	2	37	0.137
	Yes	1	3	
VSD-PDA	No	3	39	0.822
	Yes	0	1	
History of cardiac disease	No	3	33	0.428
	Yes	0	7	
History of pulmonary disease	No	3	36	0.565
	Yes	0	4	
Diabetes	No	3	37	0.623
	Yes	0	3	
Age	>36	2	29	0.305
	<36	1	11	
Ejection fraction (%)	>31	0	12	0.173
	<31	1	30	
Delayed postoperative ambulation (>24 h)	No	2	39	**0.027**
	Yes	1	1	
Hypertension	No	3	30	0.323
	Yes	0	10	
Familial history of congenital heart disease	No	2	28	0.154
	Yes	1	12	
History of tobacco use	No	3	37	0.063
	Yes	0	3	
Infusion of blood products	No	3	35	0.565
	Yes	0	5	
Infusion of plasma	No	3	38	0.720
	Yes	0	2	

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Original Article

Does Depression Change the Levels of Inflammatory Markers in Patients With Acute Myocardial Infarction in the Hospitalization Period?

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ABSTRACT

Background: Myocardial infarction (MI) is a major cause of death worldwide. Several acute-phase inflammatory proteins such as interleukin-6 (IL-6) and C-reactive protein (CRP) have been examined as the potential indicators of atherosclerosis and the risk of coronary artery disease (CAD). This study aimed to examine whether inflammation could explain the relationship between depression and CAD.

Methods: In this repeated-measure cross-sectional study, we measured CRP and IL-6 in 162 patients with acute MI at the time of admission and on the fifth day. The patients were categorized into depressed and non-depressed groups based on the Beck Depression Inventory questionnaire. Additionally, on the fifth day of hospitalization, a checklist of acute MI complications was completed for each patient.

Results: The depressed patients had a significantly higher mean value of IL-6 and CRP than the non-depressed group (for IL-6, F=17.06 and *P*<0.001; for CRP, F=8.92 and *P*=0.002). Moreover, the depressed patients experienced more post-MI brady- and tachyarrhythmias.

Conclusions: The depressed patients with acute MI had a higher level of inflammatory factors and more complications such as arrhythmias in their hospitalization period, which might have affected their prognosis. Therefore, it is imperative that more attention be paid to CAD patients with depressed mood in terms of the management and assessment of their prognosis. ***(Iranian heart Journal 2018; 19(3): 20- 29)***

KEYWORDS: Myocardial infarction, Inflammatory factors, Depression, Interleukin-6, C-reactive protein

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Coronary artery disease (CAD) is responsible for approximately one-third of deaths worldwide, and that figure will surely increase in both developing and developed countries as risk factors for the disease—primarily dyslipidemia, hypertension, obesity, diabetes, physical inactivity, poor diet, and smoking—continue to increase. [1, 2] Despite the increasing rate of deaths and CAD risk factors, clinical treatment regimens are effective and reducing the incidence. However, there is still a need for a better understanding of the underlying mechanisms. Atherosclerosis, once thought to be the bland accumulation of lipid in the arterial wall, is now recognized to have a prominent inflammatory component. [3] The substrate for the development and progression of the atherosclerotic lesion is complex and poorly understood. The inadequacy of the current knowledge was recently illustrated in the JUPITER trial, [4] which showed that even in the patients without traditional risk factors—but with elevated high sensitivity C-reactive protein (CRP) levels—statin therapy significantly reduced the incidence of major cardiovascular events. [5]

A better understanding of the inflammatory cascade involved in the atherosclerotic disease process could lead to a better risk stratification and more targeted therapy for CAD and atherosclerosis. Several acute-phase inflammatory proteins such as interleukin-6 (IL-6), CRP, cytokines, and intracellular adhesion molecules have been examined as the potential risk factors for underlying atherosclerosis and the risk of future cardiovascular events such as myocardial infarction (MI). [6] Those who have higher levels of inflammatory factors have more MI complications during days 1 to 5. [7] In addition, a curved time course with elevated levels already on admission is seen with IL-6. [6, 7]

The acute coronary syndrome (ACS) is associated with a massive acute inflammatory response. [5] The magnitude of the acute inflammatory response during the ACS is predictive of a poor cardiac outcome. Biasucci et al [8] showed that patients suffering from unstable angina with elevated levels of IL-1Ra and IL-6 measured 48 hours after admission had a greater risk of in-hospital cardiac events. Elevated CRP predicts 14-day mortality in unstable angina and non–Q-wave MI independently of troponin responses. [9, 10]

Depression is a common disorder in patients suffering from CAD, with a prevalence rate nearly 3 times that in the general population. [11] Depression is also associated with worse cardiac prognoses and greater mortality rates. [10] However, there is still considerable debate regarding how depression contributes to a worse cardiac outcome or a higher mortality rate. [12] Inflammation is seen in both cardiac disease and depression and is a plausible physiological link between depression and CAD. Several cross-sectional studies have demonstrated an association between depression and inflammation in otherwise healthy subjects [13, 14] and also in cardiac patients. [12, 15] Still, relatively little is known about the nature of the association between all the 3 variables of inflammation, outcomes following the ACS, and depression.

Accordingly, in the present study, we sought to describe the association between changes in inflammatory biomarkers during hospitalization in patients with acute MI with and without depression.

METHODS

This repeated-measure cross-sectional study recruited 172 patients with acute MI who were under medical follow-up and admitted to 2 university-based hospitals of Noor and Chamran (academic hospitals affiliated to Isfahan University of Medical Sciences, Isfahan, Iran) with first acute MI between February and August 2013. Consecutive sampling was used for selecting samples from the patients referred to these hospitals.

All the patients were evaluated by a cardiologist and were diagnosed with acute MI based on the World Health Organization's definition. [16] The inclusion criteria for the participants were: 1) age younger than 65 years; 2) hemodynamic stability; 3) the ability to read and write; 4) no previous history of the ACS; 5) willingness to participate in the study; 6) no history of major psychiatric disorders such as depression, anxiety, and major depressive disorder; and 7) no current treatment with statins. The exclusion criteria comprised the presence of any organic disease such as adrenal, hepatic, thyroid, autoimmune, and rheumatologic disease, as well as any history of malignancies, allergies, and medications with an impact on the inflammatory process such as corticosteroids and statins. Ten patients were excluded because of unwillingness to participate in the study or meeting some of the exclusion criteria. After the patients were given full explanations about the study, informed consent was obtained from all the participants. The study protocol was approved by the Ethics Committee of the Cardiovascular Research Institute of Isfahan University of Medical Sciences.

Measurements

At the time of admission, a trained nurse took venous blood samples from all the participants. After the confirmation of the hemodynamic stability of the study subjects, they were asked to complete a questionnaire to determine demographic characteristics such as age, gender, education level, smoking status, and past history of hypertension, diabetes, and dyslipidemia.

The Beck Depression Inventory (I) (BDI [I]), which is a 21-item self-report questionnaire was used to determine whether the subjects presented clinical symptoms of depression. This 4-point scale ranges from 0 to 63, with a cutoff value of 17. Scores of 17 and above are considered to denote depression. [17] The patients with acute MI were then categorized into depressed and non-depressed groups.

The anthropometric characteristics of height, weight, and the waist circumference were measured with the participants wearing hospital clothing and light slippers. The waist circumference was measured in the standing position, midway between the lowest rib and the iliac crest with a flexible anthropometric tape. The body mass index (BMI) was computed as weight (kg) divided by height (m) squared. Blood pressure was measured in the right arm in the sitting position with a standard mercury sphygmomanometer.

On the fifth day of hospitalization, venous blood samples were taken again and a checklist of acute MI complications was completed by a cardiologist based on the patients' hospital documents—including recurrent MI, mechanical complications (septal and free wall rupture), respiratory arrest, cardiogenic shock, bradyarrhythmia, tachyarrhythmia, and extrasystole.

The venous blood samples that were obtained from all the patients at the time of admission were used for laboratory tests—including blood glucose, white blood cells, lipid profiles, CRP, and IL-6. The measurement of CRP and IL-6 was repeated on the fifth day of hospitalization as well. The lipid profile— consisting of total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides (TGs)—was measured via the enzymatic method with an ELAN 2000 autoanalyzer. The Friedewald formula was applied to calculate the LDL-C level, while in the individuals with a minimum TG level of 400 mg/dL, the level of LDL-C was measured directly. The blood glucose measurement was done with the same machine and Biosystem (France) kits. The level of CRP was measured with a Hitachi 902 autoanalyzer (Japan) using Pars Azmoon (Iran) analytical kits. The level of IL-6 was measured via the standard enzyme-linked immunosorbent assay (ELISA) with Boster Biological Technology Ltd (Wuhan, China) kits.

Statistical Analysis

The demographic characteristics and the cardiovascular risk factors were compared between the groups using the 2-sample independent *t*-test and the χ^2 test. The Fisher exact test was utilized to compare the hospital complications between the 2 groups. The patients with acute MI were categorized into a depressed group and a non-depressed group. A general linear model (GLM) analysis was employed for repeated measures to evaluate both between-groups and within-groups differences in the levels of IL-6 and CRP for all the time points. The IL-6 and CRP levels were assessed on 2 occasions: day 0 (first day of hospitalization) and day 5. The levels of IL-6 and CRP which were distributed normally were recorded as a separate variable for each assessment; thus, a within-subjects factor was defined in 2 levels for the 2 assessments. A separate GLM analysis was performed using age, smoking, TC, and HDL as covariates to check their interactive effect on the IL6 and CRP differences between the 2 groups. A pairwise analysis with the Student *t*-test was used for comparisons in each time point. The Statistical Package for Social Sciences software (SPSS Inc, Chicago, Illinois, USA), version 15.0, was used for the analyses. A *P* value of 0.05 or less was considered statistically significant for all the analyses.

RESULTS

A total of 162 patients with acute MI, comprised of 127 men and 35 women at a mean age of 61.07±13.71 years, were categorized into depressed and non-depressed groups. In the depressed group, 62 (74.7%) patients were male and 6 (7.2%) were graduated. Apropos of the demographic characteristics, there was a significant difference in age between the non-depressed group (64.73±11.91) and the depressed group (59.58±14.07) (*P*=0.03). Regarding the cardiovascular risk factors, there were significant differences in smoking status (*P*=0.01), CT (*P*=0.02), and HDL (*P*=0.01) between the 2 groups at the baseline of assessment. Albeit not significantly different, the BMI, systolic blood pressure, fasting blood glucose, and LDL were higher in the depressed patients.

On the fifth day of hospitalization, significant differences were observed in the incidence of bradyarrhythmia (*P*=0.009) and tachy-arrhythmia (*P*=0.001) in the hospital complications between the 2 groups. In addition, 2 cases of septal and free wall rupture and 2 cases of respiratory arrest were observed on the fifth day of hospitalization (Table 1). Table 2 shows the bivariate analysis of the levels of IL-6 and CRP in the 2 study groups at baseline and on day 5 of hospitalization.

The GLM analysis was used to compare IL-6 and CRP at baseline and on day 5 of hospitalization between the depressed and non-depressed patients. Significant values for repeated assessments (the within-subjects factor; F=16.23 and *P*<0.001) and their interaction with the groups (the between-groups factor; F=11.15 and *P*=0.003) were found using the GLM multivariate test, indicating that both of them contributed to the model.

In the between-groups analysis, the depressed patients had a significantly higher mean of IL-6 and CRP levels than the non-depressed group. The CRP values on day 5 did not differ significantly between the 2 groups. The GLM analysis showed major between-groups effects (non-depressed vs depressed) for the levels of IL-6 (F=17.06 and *P*<0.001) and CRP (F=8.92 and *P*=0.02).

In the within-groups analysis, the mean value of the IL-6 and CRP levels had significant differences regarding the time course of the trial. The GLM analysis showed major within-groups effects for the levels of IL-6 (F=19.25 and *P*<0.001) and CRP (F=12.04 and *P*<0.001).

The GLM analysis revealed significant interactions between the changes in the levels of IL-6 (F=16.25 and *P*<0.001) and CRP (F=7.35 and *P*=0.037) and the non-depressed

group versus the depressed group at baseline and 5 days later. Hence, the GLM analysis illustrated that the change in the levels of IL-6 and CRP over the course of the trial was greater in the depressed group than in the non-depressed group. After sex, age, smoking, CT, and HDL were entered in the analysis as covariates, no significant changes were found.

Table 1. Comparisons of the demographic characteristics, risk factors, and in-hospital complications between the depressed and non-depressed groups

Variable	No Depression n=79 (48.8%)	Depression n=83 (51.2%)	*P*
Demographic Characteristic			
Age (y)	64.73±11.91	59.58±14.07	**0.03**
Sex (male), %	65 (82.3%)	62 (74.7%)	0.29
Education (graduate), %	10 (12.7%)	6 (7.2%)	0.63
Risk Factor on the First Day			
Current smoker, %	23 (29.1%)	34 (41.0%)	**0.01**
Past history of hypertension, %	23 (29.1%)	35 (42.1%)	0.15
Past history of diabetes, %	17 (21.5%)	18 (21.7%)	0.98
Past history of dyslipidemia, %	16 (20.2%)	22 (26.5%)	0.54
Body mass index	25.78±3.70	26.52±4.05	0.28
Waist circumference (cm)	95.51±10.66	94.56±10.47	0.62
Systolic blood pressure (mm Hg)	131.98±26.95	138.79±26.10	0.15
Diastolic blood pressure (mm Hg)	85.37±19.16	84.00±17.96	0.67
White blood cells	11566.66±13029.17	15738.80±21350.45	0.18
Fasting blood glucose (mg/dL)	127.31±53.09	143.22±55.75	0.09
Triglyceride (mg/dL)	134.29±67.14	133.07±52.17	0.90
Cholesterol (mg/dL)	162.35±32.26	176.72±39.22	**0.02**
Low-density lipoprotein (mg/dL)	94.96±32.72	104.21±38.61	0.13
High-density lipoprotein (mg/dL)	48.90±13.86	43.32±9.74	**0.01**
In-hospital Complication on the Fifth Day			
Recurrent myocardial infarction, %	1 (1.3%)	1 (1.2%)	0.97
Mechanical complication (septal and free wall rupture),%	0 (0.0%)	2 (2.4%)	0.14
Respiratory arrest, %	1 (1.3%)	2 (2.4%)	0.53
Cardiogenic shock, %	1 (1.3%)	0 (0.0%)	0.48
Bradyarrhythmia	2 (3.0%)	11 (13.2%)	0.009
Tachyarrhythmia	8 (10.1%)	23 (27.7%)	0.001
Extrasystole	4 (5.1%)	12 (14.5%)	0.15

Table 2. Analysis of the changes in the levels of interleukin-6 and C-reactive protein at the time of admission and on the fifth day in the depressed and non-depressed groups (mean±SD)

Variable		No Depression	Depression	*P*
Interleukin-6 (mg/dL)	First day	35.34±10.96	46.87±11.96	<0.001
	Fifth day	34.81±9.69	37.39±10.79	0.02
	P	0.81	<0.001	
C-reactive protein (mg/dL)	First day	23.31±7.18	28.94±8.21	0.01
	Fifth day	33.77±11.39	33.15±10.67	0.45
	P	<0.001	0.01	

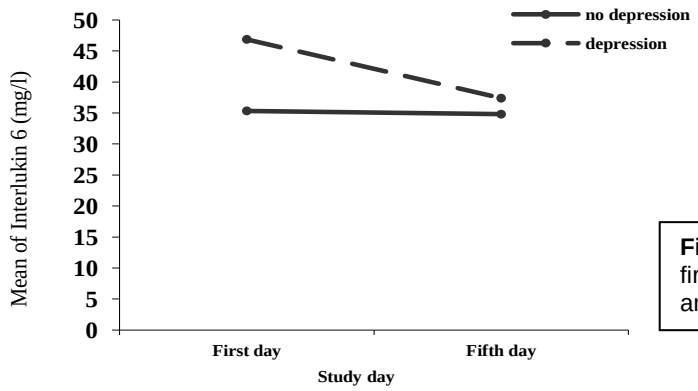

Figure 1. Mean of the level of interleukin-6 on the first and fifth days in the groups with depression and no depression

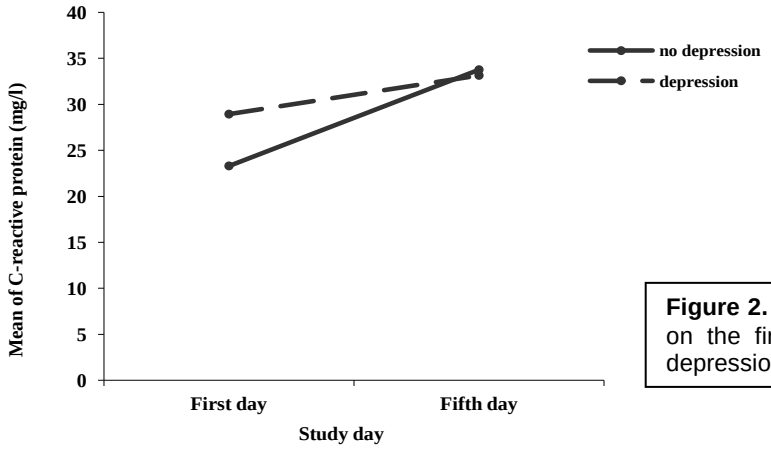

Figure 2. Mean of the level of C-reactive protein on the first and fifth days in the groups with depression and no depression

DISCUSSION

In the present study, we investigated the role of inflammation in the relationship between depression and CAD. We found that in the hospitalization period of patients with acute MI, the changes in the levels of CRP and IL-6—as the established biomarkers of inflammation—were more pronounced in those with depression than in their non-depressed counterparts. In addition, complications such as arrhythmias were more commonly seen in the former group during hospitalization.

Concerning cardiovascular risk factors, we found a higher frequency of some of these risk factors in the depressed patients with acute MI than in their non-depressed counterparts, which is in line with previous studies. [18, 19] For instance, in our study, the HDL level in the depressed patients was found to be significantly lower than that in the others. Some potential mechanisms that are propounded for dyslipoproteinemia in patients with depression include adverse behaviors, unhealthy lifestyle, and reduced exercise capacity. [19] Conversely, declining physical activity predicts more depression symptoms. [20]

We found a higher prevalence of smoking in the depressed group than in the non-depressed one. This finding is concordant with that reported by previous studies insofar as cigarette smoking is frequently co-morbid with depression and it is harder for patients with depression to quit smoking. [21, 22] Two sets of

explanations have been presented for this co-morbidity. Several studies have demonstrated common genetic and environmental influences as the reason for the co-morbidity of smoking and depression. [23, 24] On the other hand, the relationship could be in a causal manner. Depression increases the risk of smoking, or smoking increases the risk of depression. Cigarette smoking could be a result of self-medication for depressive symptoms or smoking may increase the risk of depression. [25, 26] If smoking and hyperlipidemia are more prevalent or more severe in depressed than in non-depressed patients, then depressed patients might be at increased risk for cardiac events not because of their depression, but instead due to these other risk factors.

However, there are several reasons to doubt this possibility. First, some studies which have shown depression to predict cardiac events have failed to find any association between depression and these risk factors. [27, 28] Second, depression has remained an independent predictor of cardiac morbidity and mortality after controlling these risk factors. [29, 30] Third, as we found in the current study, the mean age at the time of the MI occurrence in the depressed patients was less than that in non-depressed ones, which is consistent with some prior studies. The lower age of CAD in depressed patients makes atherosclerotic events or its risk factors a less possibility; therefore, some intrinsic factors other than atherosclerosis risk factors might be responsible as the cause of MI in these patients. [28] With an improved understanding of the pathogenesis of CAD, the most possible factors are certain markers of inflammation as indicated in a variety of recent investigations which have shown that inflammation has a great role in the progression of atherosclerosis. Among the vast array of serologic markers of systemic inflammation, CRP and IL-6 have been the most thoroughly investigated. Possible mechanisms exist for a bidirectional relationship between inflammation and depression. Each one could be the cause or the result of the other one. Another scenario having been previously presented is the contribution of common genetic variants to depressive symptoms and inflammatory markers. [14] We suggest that the relationship between depression and CAD could be mediated by inflammation. Stewart et al, [13] in a cross-sectional study in 2009 among 263 healthy elderly men and women enrolled in the Pittsburg Healthy Project (a 6-year prospective cohort study), found that inflammation might be one of the mechanisms through which depression contributed to cardiovascular risk. A study in 2013 showed that the potential pathway to explain the relationship between depression, inflammation, and increased cardiovascular thrombosis might be found when both platelet activation and inflammation were measured. [31]

The inter-relationships between depression, inflammation, and CAD or its outcome have been previously evaluated and some possibilities have been presented. Depression might induce inflammation, which in turn can mediate the relationship between depression and CAD. Inflammation by itself might also lead to depression. Either depression or inflammation might cause CAD through separate mechanisms; as a result, depression and inflammation might have a common precursor which is linked to CAD. Depression is probably the proximal mediator through which inflammation increases the risk for CAD events. Of course, the relationship between depression, inflammation, and CAD could be more complex and there are other possible scenarios. [32] Nonetheless, only a few studies have examined these possibilities. Vaccarino et al [29] measured CRP and IL-6 in women with suspected coronary ischemia who completed the BDI. They reported that the women with depression had a 70% higher CRP level and a 25% higher IL-6 level than those without depression, and they considered depression to be a significant predictor of CAD. It means that inflammatory biomarkers might explain the

association between depression and CAD. Similarly, Empana et al [33] and Davidson et al [15] suggested that depressive mood was related to CAD due to these inflammatory markers.

With respect to hospital complications, we found that the depressed patients with a higher range of inflammatory factors experienced significantly more brady- and tachyarrhythmias in their hospitalization period than the other patients. This finding is consistent with the data from previous studies which have indicated that the prognostic impact of post-MI depression is related to arrhythmia. [12, 31] Such findings confirm the independent risk associated with elevated BDI scores and demonstrate that the impact of depression is highlighted in patients with arrhythmias. Most studies have shown that patients with atrial fibrillation have an increased incidence of depression and anxiety due to an impaired quality of life. [12, 34, 35] On the other hand, prospective trials have shown that the elevated levels of CRP and other inflammatory factors measured at baseline are associated with adverse cardiovascular prognoses among healthy individuals as well as among those at high risk. The level of IL-6 has been linked to increased morbidities in unstable angina and acute MI. [7]

The present study has a few limitations. We evaluated the complications only in the hospitalization period. A better understanding of this association requires longitudinal studies with longer durations.

Because we measured the depression score once at baseline and in the paper-pencil method, we were unable to assess the possible impact of its changes on CAD events. Another weakness of note is that we did not examine other psychiatric or personality disorders in our patients, which may have negatively impacted our results.

In conclusion, we observed that the depressed patients with acute MI in our study had a higher level of inflammatory factors in their hospitalization period than their non-depressed counterparts and they experienced more complications such as arrhythmias at this time, which might have affected their prognosis. Therefore, it is imperative that we pay more attention to CAD patients with depressed mood in respect of the management and assessment of their prognosis.

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Conflict of Interest: The Authors declare that there is no conflict of interest.

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Original Article

Comparison Between Ultrasound Guidance and the Landmark Technique for the Internal Jugular Vein Cannulation in Adult Patients by Anesthesia Residents or Inexperienced Operators

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ABSTRACT

Background: The cannulation of the internal jugular vein is done to access the central vein for hemodynamic monitoring and other purposes. A safe internal cannulation of the jugular vein is performed using anatomical landmarks on the surface of the skin or using the ultrasound-guided method. In this study, we compared the ultrasound-guided technique and the anatomical landmark method for the internal insertion of the jugular vein catheter by anesthesia residents on adult patients in terms of the rates of their success rate and complications.

Methods: In this study, 90 patients were divided into 2 equal groups. The anatomical landmark technique was used in the first group and ultrasound guidance in the second group to cannulate the internal jugular vein. In both methods, the number of attempts, the rate of failure, the rate of carotid rupture, and the rate of complications such as pneumothorax, hematoma, and arrhythmias were documented.

Results: There was no statistically significant difference between the 2 groups vis-à-vis the number of the attempts to catheterize each patient (P=0.352). Cannulation failure was reported in only 1 patient in each group, and there was no significant difference between the 2 groups (P=0.062). The results demonstrated no significant difference between the groups (P=0.750) concerning the rate of complications of the internal jugular vein catheterization.

Conclusions: Neither of the methods of ultrasound guidance and anatomical landmarks had a significant superiority in terms of the success rate and the complications of the insertion of the internal jugular vein catheter. The reason for the absence of a significant difference between the 2 groups in the above parameters was the anesthesia residents' insufficient personal skills in performing ultrasound. ***(Iranian heart Journal 2018; 19(3): 30-37)***

KEYWORDS: Ultrasound, Anatomical criteria, Central vein catheterization

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Catheterization is often regarded as a critical component of pre- and postoperative care in severely ill patients for diagnostic or therapeutic purposes. Approximately, 6 million central venous catheterizations are done each year in Europe and the United States. [1] The benefits of these central venous catheters include their ability to record the central venous pressure or other hemodynamic parameters, their ability to infuse very strong drugs (eg, catecholamines) or highly stimulating ones (eg, chemotherapy drugs and parenteral nutritional solutions), and their ability to confer dialysis treatment in cases of renal failure.

The internal jugular, subclavian, and femoral veins are usually used to access the central vein. The femoral vein catheterization has always been an attractive way to access the central vein because it is accessible in most patients and suitable for various indications. It also has fewer complications during the insertion. [2] However, the disadvantages include the inability to perform hemodynamic invasive monitoring and higher risks of thromboembolic and infectious complications. [3] Consequently, access to the central vein is preferred using the internal jugular vein or the subclavian vein.

The catheterization of the internal jugular vein is performed in critically ill patients in order to access the central vein for hemodynamic monitoring; the long-term administration of fluids, antibiotics, and venous parenteral nutrition; and hemodialysis. A safe internal cannulation of the jugular vein is done by using anatomical landmarks on the surface of the skin before finally passing a needle through a hypothetical vein line. Since 1966, many techniques have been developed based on anatomical landmarks. [4, 5] The complications of this technique depend on factors such as the body mass index, the location of the attempt to access the vein, and the physician's experience. [6, 7] In addition, failure in the cannulation of the internal jugular vein occurs in 19.4% of cases. [6]

It has been posited that ultrasound guidance can be beneficial by improving the success rate, decreasing the number of needle entry points, and reducing complications in the insertion of the central vein catheters. [8, 9] Ultrasound may also be used in patients whose central vein is difficult to access or in those who are more likely to develop complications later on. [10]

Today, the use of an ultrasound device by specialists is rising rapidly. On the other hand, most patients who require a central vein are critical and meticulous care should be taken to perform the procedure in the shortest time possible and with the fewest complications. Various studies have been conducted to compare the use of the ultrasound-guided method and the anatomical landmark technique on the central venous veins—especially the internal jugular vein—and the majority of them have favored ultrasound guidance. [11]

In the current study, we evaluated the use of an ultrasound device by anesthesia residents without a great deal of experience in the 2 methods of ultrasound guidance and anatomical landmarks to access the internal jugular vein. Additionally, factors such as time reduction, the number of attempts (the number of needling), the success rate of the venous access, and the complications were investigated. [12-14]

METHODS

Permission to conduct the study was obtained from the institutional ethics committee. The research conditions were described to the study participants, and written consent was obtained. In this clinical trial (registration number: IRCT2014112520079N1), patients were selected via simple randomized sampling. The inclusion criteria comprised patient satisfaction, required collaboration for the internal jugular vein cannulation, age over 18 years, and not having coagulation disorders. The exclusion criteria consisted of pregnancy, sensitivity to topical anesthetics, infection or burning of the neck region for the internal jugular vein cannulation, peripheral vascular disease,

coagulopathy, obesity, abnormal anatomy, intravenous drug addiction, and thrombosis.

The study population was comprised of 90 patients, who were divided into 2 equal groups. The anatomical criteria were used in the first group, while the ultrasound-guided method was implemented in the second group for the cannulation of the internal jugular vein. The investigator prepared the patients, placed their neck in the right position for cannulation, and prepped and draped their neck. Required monitoring for the patients—including blood pressure control via a noninvasive method for 5 minutes, electrocardiography, and continuous arterial oxygen saturation with pulse oximetry—was established. Oxygen was supplied to the patients with masks or nasal cannulae.

Under the sterile condition and using the vertices of a triangle at the site of the junction, the sternocleidomastoid muscle became numb with 2 cc of xylocaine 2% by the researcher.

In the anatomical landmark technique, a 2-cc syringe with a 22-gauge needle at an angle of 45° was guided toward the nipple. As soon as blood was removed from the internal jugular vein, a 19-gauge needle tip, which was connected to a 10-cc syringe, was directed toward the path of the 22-gauge needle. After the withdrawal of blood from the internal jugular vein, a guide wire was entered into the internal jugular with the needle. Subsequently, the central venous catheter was entered into the central vein after the dilation of the path. Next, the route of the catheter was checked, and the catheter itself was fixed to the skin.

In the ultrasound-guided method, a linear probe was implemented. The device was set at a depth of 4.5 cm. Gel was laid on the probe, which was also coated with sterile covers. The anatomy of the aforementioned area—including the carotid artery and the internal jugular vein—and the capability of compression in the jugular vein were checked first. Afterward, the jugular vein was cannulated with the in-plane technique within the space between the 2 ends of the sternocleidomastoid muscle with a 10-gauge needle, which was connected to a 10-cc syringe. As soon as blood was drained, a guide wire was entered and dilatation was done. Finally, the catheter was inserted through the guide wire. After the catheter was checked, it was fixed to the neck skin.

In the present study, no patient was excluded for being a so-called "difficult stick" due to peripheral vascular diseases, coagulopathy, obesity, abnormal anatomy, injection drug addiction, or thrombosis. In both techniques, the number of attempts, the rate of failure, and the rate of complications such as pneumothorax, hematoma, and arrhythmias were recorded. In case of premature ventricular contractions or any other arrhythmias, the guide wire was removed until the arrhythmia was eliminated. The duration of the anatomical landmark method, from the insertion of the 22-gauge needle until the removal of blood with the 19-gauge needle, was accurately recorded by the investigator. Additionally, the duration of the ultrasound guidance method, from the placement of the SONO probe on the skin until the withdrawal of blood from the 19-gauge needle, was carefully recorded by the assistant or the researcher.

Sample Size

The sample size was determined to be 90 patients using the standard deviation of reference studies and the following formula in which 45 individuals were considered to be in each group:

$$n = \frac{2(Z_1 - {}^{\alpha}/_{2} + Z_1 - \beta)^2 Q^2}{d^2}$$

Method of Data Collection and Analysis

The patients' demographic data and other variables were measured or extracted and subsequently recorded in a form. The collected data were analyzed with SPSS. The comparative value of the data was considered statistically significant with a *P* value less than 0.05.

RESULTS

The study population consisted of 90 patients: 31 (68.9%) men and 14 (31.1%) women in the anatomical landmark method group and 33 (73.3%) men and 12 (26.7%) women in the ultrasound guidance group. The data analysis with the χ^2 test showed no significant difference between the 2 groups (*P*=0.810) (Fig. 1). The mean age of the patients was 57.2±16.8 years in the anatomical landmark method group and 55±16.5 years in the ultrasound-guided method group. The one-way analysis of variance (ANOVA) indicated that there was no significant age difference between the 2 groups (*P*=0.122).

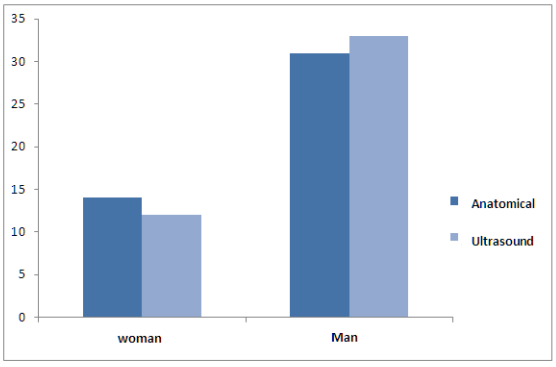

Figure 1. Gender segregation of the patients in the 2 groups

The mean body mass index was 25.9±3.3 in the anatomical landmark technique group and 27.4±3.3 in the ultrasound guidance group; there was no significant difference between the 2 groups (*P*=0.460).

The average cannulation time of the patients was calculated with a chronometer. The mean time was 41.6±32.4 seconds in the anatomical landmark technique group and 65.4±31.3 seconds in the ultrasound-guided method group. Despite the 24-second interval between the 2 groups, the data analysis showed no significant difference between them (*P*=0.662).

The results revealed that cannulation had failed in only 1 patient in each group, and there was no statistically significant difference between the 2 groups (Fig. 2).

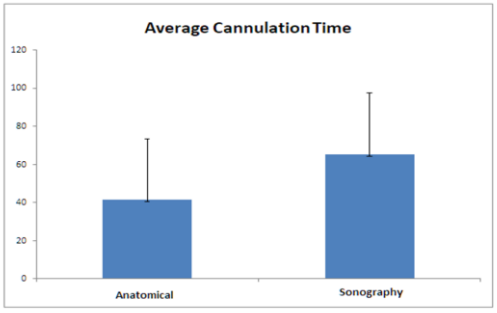

Figure 2. Average time of the internal jugular vein cannulation in the patients of the 2 studied groups

In this study, the number of attempts to catheterize each patient was also recorded. The mean number of attempts was 2±2.1 in the anatomical landmark technique group and 1.6±0.8 in the ultrasound guidance group. The ANOVA showed no significant difference between the 2 groups in this regard (*P*=0. 352).

The cases that led to the severity of the patient's cannulation were also recorded. In the anatomical landmark technique group, 1 (2.2%) patient suffered peripheral vascular disease, 1 (2.2%) patient was addicted to drug injection, 14 (31.1%) patients had coagulation problems, and 3 (6.6%) patients had short necks. In the ultrasound guidance group, 2 (4.4%) patients were addicted to drug injection, 7 (15.5%) patients had coagulation problems due to the use of medication, and 4 (8.9%) patients had short necks. The data analysis showed no significant difference between the 2 groups in this regard (*P*=0.225) (Fig. 3).

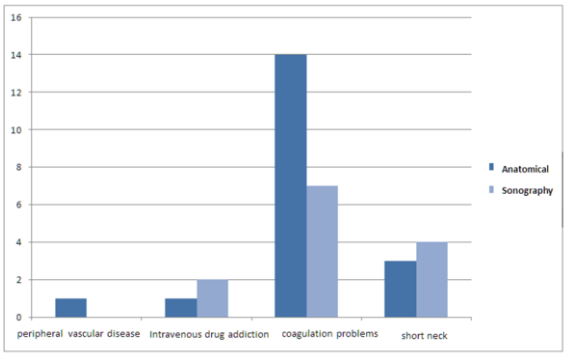

Figure 3. Different cases leading to difficulty in the cannulation of the internal jugular vein in the patients of the 2 studied groups

The complications of the internal jugular vein catheterization were evaluated in the 2 groups. In the anatomical landmark technique group, 4 (9.9%) patients had hematoma, 4 (9.9%) patients had the carotid rupture, and 3 (6.6%) patients had arrhythmias. In the ultrasound-guided method group, 4 (8.9%) patients suffered hematoma, 4 (9.9%) patients experienced carotid rupture, and 2 (4.4%) patients developed arrhythmias. The ANOVA showed no significant difference between the 2 groups (*P*=0.750) (Fig. 4).

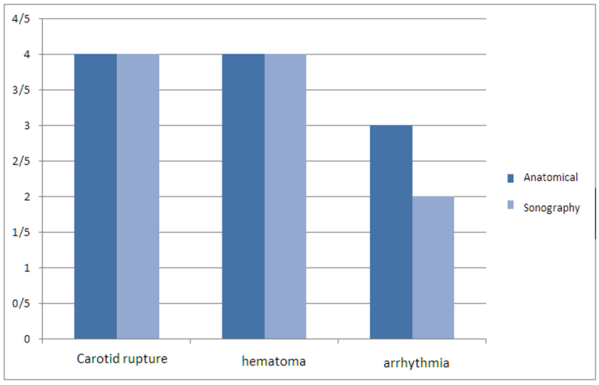

Figure 4. Complications of the internal jugular vein cannulation in the patients of the 2 studied groups

The reason for the absence of significant differences between the 2 study groups in the above parameters was that the anesthesia residents had insufficient personal skills in the ultrasound-guided technique. Moreover, there were no ultrasound devices in all the centers which could be commonly used. Residents use the anatomical criteria commonly for the catheter insertion; therefore, the complications in this group are not significantly higher than those in the ultrasound method.

DISCUSSION

In the present study, neither of the methods of ultrasound guidance and anatomical landmarks had a significant superiority in terms of the success rate of the internal jugular vein catheterization. Nonetheless, the use of the anatomical criteria reduced approximately one-third of the time compared with the ultrasound method, although this difference failed to constitute statistical significance (*P*=0.062).

Contrary to the hypothesis that the use of ultrasound guidance, by comparison with the anatomical landmark technique, facilitates the insertion of the internal jugular vein catheter, ultrasound did not significantly improve the procedure with respect to the cannulation time, the success rate of cannulation, and the incidence of carotid rupture. The results of most of the studies in this area are not concordant with those obtained in the current study. In all the previous investigations, ultrasonography had a significant advantage over the anatomical landmark method with regard to the success rate, cannulation time, and complication rates.

Be that as it may, Hayashi et al [8] indicated that ultrasound guidance prior to the internal jugular vein cannulation failed to confer any superiority relative to the anatomical criteria, which is in part consistent with the results of the present study. It has been proven in previous studies that the use of ultrasound guidance increases the success of the internal jugular vein cannulation and reduces the incidence of arterial rupture. Some researchers have recommended the application of the ultrasound-guided method to determine the correct location of the internal jugular vein before the insertion of catheters. [15] Furthermore, the superiority of the method of ultrasonography over anatomical landmarks has also been proven in a study by Nadig et al. [16]

In a study by Leung et al, [2] the cannulation of the internal jugular vein was assessed in 130 critical patients in the emergency department and the results showed that catheterization with ultrasound had a higher rate of success and fewer complications. The results obtained in a study by Turker et al [13] on 380 patients who needed the internal jugular vein catheters showed that the use of ultrasound resulted in less access time and a lower rate of acute complications. In a similar study by Karakitsos et al [12] on 900 severely ill patients who were equally subjected to jugular venous cannulation

via conventional and sonographic methods, it was reported that catheterization with ultrasound guidance was more successful than the traditional method. The ultrasound-guided technique should, therefore, be employed as a selective method in this group of patients.

Gordon et al [17] evaluated 869 patients who underwent the internal jugular vein cannulation under ultrasound guidance and found that ultrasound-guided cannulation was superior to blind techniques as not only did it boost the success rate and the likelihood of successful catheterization in the first attempt but also it reduced the rate of acute complications.

Mey et al [18] evaluated the ultrasonography technique for accessing the central vein through the internal jugular vein in 493 patients and showed that this method had a high success rate and a low rate of complications. The authors also concluded that difficulty in cannulation due to individual risk factors such as thrombocytopenia, obesity, and dyspnea could be easily managed with the application of ultrasound guidance and argued that the success rate and the severity of the complications depended not only on the experience of the physician carrying out the cannulation but also on the experience of the physician performing the ultrasound.

In the current study, the internal jugular vein cannulation via the clinical criteria was successful in 97.8% of the cases. This finding is consistent with studies in which the success rate of this technique was estimated to be between 85% and 99%. [4, 6, 9, 17, 19] The success rate of the internal jugular vein catheterization using anatomical landmarks in the study by Turker et al [13] was about 97.3%. The success rate of cannulation in the study by Karakitsos et al [12] was 99.4% in the anatomical landmark group and 100% in the ultrasound group. The success rate of ultrasound in the present study was 97.8%, which was equal to that of the anatomical landmark method. This finding does not chime in with the results previously reported on the subject. [2, 12, 13, 15, 18]

When the mechanical side effects of cannulation—namely carotid rupture, hematoma, pneumothorax, and hemothorax—were only considered, 5 (11.1%) patients in the anatomical landmark group and 7 (15.5%) patients in the ultrasound guidance group developed complications in the present study. In contrast, in the study by Turker et al, [13] 8.4% of the patients in the anatomical landmark group and 1.6% of the cases in the ultrasound guidance group suffered mechanical complications caused by cannulation. In the study by Karakitsos et al, [12] the side effects occurred in 23.1% of the patients in the anatomical landmark group and in 1.5% of the cases in the ultrasound guidance group. In the study by Leung et al, [2] in total, 10.8% of the patients—comprising 4.6% in the ultrasound guidance group and 16.9% in the anatomical landmark group—were involved with some complications. Even in the study by Hayashi et al, [15] whose results are somewhat consistent with those of the present study, the rates of the incidence of the carotid rupture in the anatomical landmark and sonography groups (3. 3% and 1%, respectively) were lower than those in the present study (8.9% in both groups).

A comparison between the results of the aforementioned studies and ours shows that the complication rate of the ultrasound guidance technique in our study was high. On the other hand, whereas all those investigations reported a significant difference between the 2 methods, we found an equal rate of mechanical complications in our 2 groups. Personal skills in using ultrasound may be one of the possible reasons for such a difference.

Indeed, personal skills in the insertion of the central venous catheter play an important role in the success rate of this process. According to recent studies, the ultrasound-guided technique causes a significant decrease in the success rate of this procedure. [9, 20, 21]

In a study by Troianos et al, [20] central venous catheters were inserted under ultrasound

guidance in all the patients in less than 3 minutes, which is consistent with the results of the current study. Furthermore, all the cases in the ultrasound group were subjected to cannulation, with even less time than that in the mentioned studies (<140 s). Nevertheless, there was a rise in the rate of complications despite this higher speed. In addition, the rate of complications in the anatomical landmark method group was almost the same or even lower than that reported by previous investigations. [2, 12, 13, 15, 17, 18] A possible cause for the high rates of complications in the current study may be the non-elimination of the so-called "difficult-stick" patients from the study given that such patients have been excluded from most similar studies.

The most important complication of the internal jugular vein cannulation is the carotid rupture. In the present study, 8.9% of the cases experienced this condition in both the anatomical landmark and ultrasound guidance groups. About 10.6% of the patients in the study by Karakitsos et al [12] also suffered this complication.

CONCLUSIONS

The results of the present study run contrary to those reported by the previous investigations which indicated the superiority of the ultrasound-guided technique over the anatomical landmark method. [2, 8, 9, 12, 13, 17, 18, 20, 21] This disparity in the results may be in consequence of the landmarks having been used, the differences in the planning of the studies, and the skill levels of the operators carrying out the procedure.

Although the use of ultrasound guidance was not superior to the traditional methods, we would recommend its utilization in patients who lack appropriate landmarks.

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Original Article

Association Between the Risk Factors for Cardiovascular Disorders and Coronary Artery Occlusion on Angiography

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ABSTRACT

Background: coronary artery occlusion is the main reason for cardiovascular disease-related deaths the world over. Hence, identifying its main determinants is essential for the proper prevention of coronary artery disease and its-related mortality and morbidity. The present study investigated the association between cardiovascular risk factors and the occlusion of coronary arteries in patients.

Methods: In this cross-sectional study, the medical records of 2046 consecutive patients with suspected cardiovascular disorders who were referred to the Angiography Center at Imam Hossein Hospital in the Iranian province of Ilam between January 2010 and January 2012 were reviewed via census sampling. Based on the angiography findings, the patients were classified as normal or involved coronary artery groups. The risk factors for cardiovascular disorders were also recorded. Binary and multivariable logistic regression models were used to determine the adjusted odds ratio (OR) for each risk factor.

Results: In the final multivariable regression modeling, the variables of gender (OR=3.44 and 95% CI: 1.02 to 5.58), age (OR=1.10 and 95% CI: 1.05 to 1.15), a family history of coronary disease (OR=1.12 and 95% CI: 1.30 to 1.94), current smoking (OR=1.50 and 95% CI: 1.02 to 1.98), systolic blood pressure (OR=1.16 and 95% CI: 1.05 to 1.28), diastolic blood pressure (OR=1.04 and 95% CI: 1.00 to 1.09), and high-density lipoprotein cholesterol (HDL-C) (OR=1.04 and 95% CI: 1.00 to 1.08) significantly increased the risk for coronary artery occlusion.

Conclusions: Among the different non-modifiable variables, gender, age, and a family history of CAD and among the modifiable variables, smoking, hypertension, and a reduced HDL-C level increased the risk for coronary involvement. Further cohort studies and meta-analyses are required to clarify the causative association between these risk factors and coronary occlusion.
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KEYWORDS: Cardiovascular disease, Risk factor, Angiography

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Cardiovascular disorders are one of the main causes of mortality in most countries in the entire world, [1] and they account for more than one-third of deaths in Western countries. [2] In Iran, more than 50% of all mortalities are caused by cardiovascular disorders, which have been identified as the major reason for deaths in different age subgroups. [3] Various underlying factors such as hypertension, dyslipidemia, cigarette smoking, and a family history of coronary artery disease (CAD) have been identified as the major triggering factors for coronary artery involvement. [4] It has been suggested that these factors may not only trigger CAD but also be responsible for the progression of CAD; a consensus over this issue, however, has yet to emerge in the medical community. [5] Several hypotheses have been proposed with regard to the potential effects of the high consumption of saturated fats and cholesterol on the formation of atheroma plaques and arterial stenosis. [6, 7] In a study by Kasaoka and colleagues [8] among Japanese diabetics, increased levels of blood pressure and serum cholesterol were not associated with the distribution of coronary lesions, but the severity of coronary lesions was significantly higher in the patients with high serum cholesterol concentrations. This relationship with respect to the increased level of cholesterol has been confirmed in most studies; nevertheless, the results obtained regarding elevated blood pressure levels and smoking are conflicting. [9, 10]

Various diagnostic approaches are available for the assessment of patients with suspected CAD. Coronary angiography is the most common method for the diagnosis of CAD. Today, more than one million individuals annually in the United States of America are undergoing cardiac catheterization for diagnosis and treatment. [11] Substantial evidence shows that this method can be drawn upon to assess not only symptomatic patients but also asymptomatic subjects with only the risk factors for cardiovascular disorders. [12] Our study aimed to determine the association between the risk factors for CAD and the odds ratio (OR) for coronary artery involvement in patients undergoing coronary angiography.

METHODS

Study Population

In the current cross-sectional study, the medical records of all consecutive patients with suspected cardiovascular disorders who were referred to the Angiography Center at Imam Hossein Hospital in the Iranian province of Ilam between January 2010 and January 2012 were reviewed through census sampling. Out of a total of 3265 recorded files, 2046 files were complete and eligible for the final review. The baseline characteristics and clinical data of the patients—including demographics, traditional risk factors for CAD, laboratory analysis results, and angiography findings—were extracted from the files by trained experts deployed on the angiography ward and recorded.

Study Parameters

In this study, the consumption of at least 10 cigarettes per day was considered a criterion for cigarette smoking. A family history of CAD was also defined as the presence of the disease in the first-degree family members (ie, sisters, brothers, father, and mother) of the patients before age 55 in men and before age 65 in women. Hypercholesterolemia was defined as a minimum total cholesterol level of 5.0 mmol/l, a minimum high-density lipoprotein cholesterol (HDL-C) level of 1.0 mmol/l in men or a minimum HDL-C level of 1.1 mmol/l in women, and minimum triglyceride levels of 2.0 mmol/l. Hypertension was defined as a minimum systolic blood pressure of 140 mm Hg and/or a minimum diastolic pressure of 90 mm Hg and/or being on antihypertensive treatment. Diabetes mellitus was defined as the presence of the symptoms of diabetes plus at least one of the following: a minimum plasma

glucose concentration of 11.1 mmol/l, a minimum fasting plasma glucose level of 7.0 mmol/l, and a minimum 2-hour post-prandial level of 11.1 mmol/l. Each patient had a standard CD of angiography, which was performed using the Seldinger method and subsequently interpreted by a single cardiologist with respect to CAD. Between-observer variations were avoided by the employment of only a single cardiologist to assess the angiography CDs.

Statistical Analysis

The results were reported as means ± standard deviations (SDs) for the quantitative variables and percentages for the categorical variables. The groups were compared using the Student *t*-test for the continuous variables and the χ^2 test (or the Fisher exact test, if required) for the categorical variables. The predictors exhibiting a statistically significant relationship with CAD were taken for a binary multivariate logistic regression analysis so as to investigate their independence as the predictors adjusted for age and the other independent parameters. ORs and 95% confidence intervals (CIs) were calculated. A *P* value of 0.05 or less was considered statistically significant. All the statistical analyses were performed using the SPSS software (SPSS Inc, Chicago, IL, USA), version 13.0, and the SAS software, version 9.1, for Windows (SAS Institute Inc, Cary, NC, USA).

RESULTS

Of the 2046 studied subjects, 937 (45.78%) were male and 1109 (54.22%) were female. In total, 791 (38.66%) patients had a normal coronary angiography and the others had abnormal angiographic findings. As is described in Table 1, in both genders, the patients with abnormal angiography features were older and had higher systolic and diastolic blood pressures than those with normal angiography findings. Nonetheless, the 2 groups were similar in terms of their lipid profile. Regarding the level of fasting blood sugar, this laboratory index was higher in the group of women with CAD than in the group of women with no CAD; however, this discrepancy was not observed in the men with and without CAD. The place of residence, defined as that in rural and urban areas, did not affect the incidence of CAD in both men and women. In both genders, a family history of CAD was more prevalent in the group with CAD than in the group with no CAD. In contrast, current smoking was more prevalent in the male patients with CAD but not in the female patients with CAD than in the patients with no CAD (Table 2). The binary univariate analysis showed that among all the baseline variables, the male gender (OR=2.15 and 95% CI: 1.78 to 2.58), age (OR=1.07 and 95% CI: 1.06 to 1.08), smoking (OR=2.00 and 95% CI: 1.52 to 2.43), a family history of CAD (OR=1.47 and 95% CI: 1.11 to 1.94), systolic blood pressure (OR=1.02 and 95% CI: 1.00 to 1.06), diastolic blood pressure (OR=2.98 and 95% CI: 2.97 to 2.99), low HDL-C (OR=1.01 and 95% CI: 1.00 to 1.02), and high total cholesterol (OR=1.100 and 95% CI: 1.09 to 2.08) were the determinants of abnormal angiography features, while LDL-C and high fasting blood sugar could not predict these abnormal coronary features. In this regard, the multivariable regression model (Table 3) revealed that the variables of gender (OR=3.44 and 95% CI: 1.02 to 5.58), age (OR=1.10 and 95% CI: 1.05 to 1.15), a family history of coronary disease (OR=1.12 and 95% CI: 1.30 to 1.94), current smoking (OR=1.50 and 95% CI: 1.02 to 1.98), systolic blood pressure (OR=1.16 and 95% CI: 1.05 to 1.28), diastolic blood pressure (OR=1.04 and 95% CI: 1.00 to 1.09), and low HDL-C (OR=1.04 and 95% CI: 1.00 to 1.08) significantly increased the risk for coronary artery occlusion.

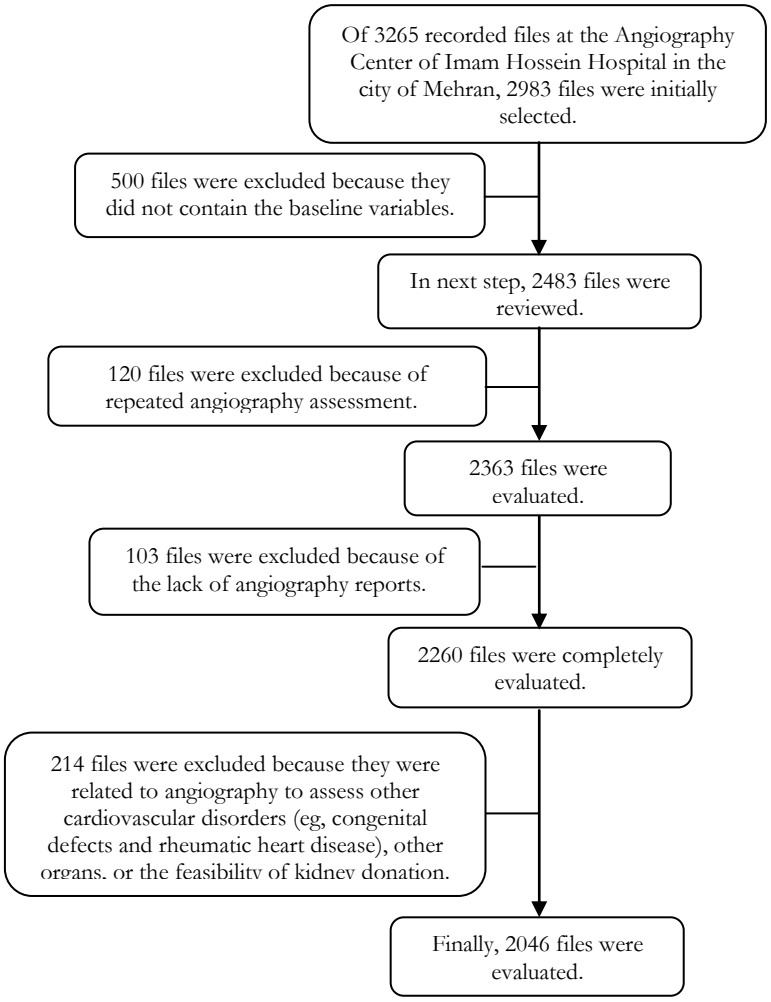

Figure 1. Description of sampling

Table 1. Coronary artery disease-related risk factors in the patients with normal and abnormal angiography features

Variable	Men			Women		
	Normal Angiography (n=269)	Abnormal Angiography (n=668)	*P*	Normal angiography (n=515)	Abnormal Angiography (n=581)	*P*
Age, y	50.8 ± 12.5	60.1 ± 12.4	< 0.001	51.8 ± 11.2	61.9 ± 10.7	< 0.001
Systolic blood pressure, mm Hg	126.1 ± 14.4	131.0 ± 20.1	< 0.001	129.4 ± 18.4	135.6 ± 20.9	< 0.001
Diastolic blood pressure, mm Hg	77.7 ± 10.2	79.4 ± 10.9	0.05	77.0 ± 12.3	78.8 ± 13.8	0.04
LDL-cholesterol, mmol/l	102.0 ± 30.0	102.5 ± 32.4	0.92	107.0 ± 34.7	109.5 ± 58.3	0.67
HDL-cholesterol, mmol/l	55.0 ± 15.5	51.7 ± 12.9	0.13	58.4 ± 15.7	58.9 ± 15.6	0.74
Triglycerides, mmol/l	136.9 ± 81.6	146.3 ± 112.8	0.39	161.8 ± 121.8	163.5 ± 112.4	0.45
Total cholesterol, mmol/l	178.1 ± 45.5	174.7 ± 53.7	0.86	186.2 ± 44.8	183.0 ± 9.5	0.15
Fasting blood sugar, mmol/l	115.8 ± 56.0	120.5 ± 60.6	0.80	111.5 ± 45.6	123.7 ± 57.3	0.02

LDL, Low-density lipoprotein; HDL, High-density lipoprotein

Table 2. Prevalence of coronary artery disease-related risk factors among those with normal and abnormal angiography findings according to gender

Variable	Men			Women		
	Normal Angiography Number (%)	Abnormal Angiography Number (%)	*P*	Normal angiography Number (%)	Abnormal Angiography Number (%)	*P*
Residency						
Urban area	234 (29.0)	574 (71.0)	0.96	456 (46.7)	520 (53.3)	0.96
Rural area	37 (29.1)	90 (70.9)		61 (46.9)	69 (53.1)	
Current smoking						
Yes	72 (24.3)	224 (75.7)	0.04	17 (39.5)	26 (60.5)	0.36
No	94 (30.5)	214 (69.5)		317 (46.7)	362 (53.3)	
Family history						
Yes	23 (17.8)	106 (82.2)	0.05	73 (38.8)	115 (61.2)	0.01
No	88 (25.9)	252 (74.1)		211 (49.4)	216 (50.6)	

Table 3. Odds ratios for the risk factors with angiography features in the men and women

Variable	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Male gender	2.15 (1.78-2.58)	< 0.001	3.44 (1.02-5.58)	0.04
Current smoking	2.00 (1.52-2.48)	< 0.001	1.50 (1.02-1.98)	< 0.001
Family history of CAD	1.47 (1.11-1.94)	0.007	1.12 (1.03-1.98)	0.009
Age	1.07 (1.06-1.08)	< 0.001	1.10 (1.05-1.15)	< 0.001
Systolic blood pressure	1.02 (1.00-1.06)	< 0.001	1.16 (1.05-1.28)	0.002
Diastolic blood pressure	2.98 (2.97-2.99)	0.004	1.04 (1.00-1.09)	0.05
LDL-cholesterol	1.00 (0.99-1.00)	0.96	0.99 (0.96-1.01)	0.45
HDL-cholesterol	1.01 (0.99-1.02)	0.05	1.04 (1.00-1.08)	0.03
Triglycerides	0.99 (0.99-1.00)	0.98	1.00 (0.99-1.00)	0.26
Total cholesterol	1.00 (1.09-2.08)	0.02	0.99 (0.98-1.02)	0.32
Fasting blood sugar	0.99 (0.99-1.00)	0.16	0.99 (0.98-1.00)	0.65

CAD, Coronary artery disease; LDL, Low-density lipoprotein; HDL, High-density lipoprotein

DISCUSSION

According to the results of the present study, among the modifiable variables, smoking, low HLD-C, and systolic and diastolic blood pressures and among the non-modifiable indicators, the male gender, advanced age, and a family history of CAD increased the risk for CAD in our population. Additionally, in the univariate regression analysis, increased levels of total cholesterol were found to be associated with increased risks for CAD; however, we eliminated the triggering effect of this variable and adjusted it for the other variables as a confounder in the multivariable regression modeling. Our study results are consistent with those reported by Hosseini et al, [14] who found that age, diabetes, and a high blood pressure were the main determinants of CAD. Therefore, the common triggering variables in their study and ours were age and hypertension, but not increased levels of blood sugar. Whereas a significant association was also observed in a study by Veeranna et al, [4] diabetes mellitus was not demonstrated as the main trigger for CAD in an investigation by Trianti and colleagues [15] in a non-Iranian community. In the current study and after adjustment for gender, both systolic and diastolic blood pressures remained as CAD risk factors. This finding chimes in with the result of a study by Nafakhi et al [16] but is in contrast to the result reported by Veeranna et al. [4]

Smoking is a widespread habit in developing countries [17] and has been shown as a major risk for CAD. [18] In our study, we found a relationship between smoking and abnormal angiography patterns in both univariate and

multivariate regression models, with this association being more pronounced in the male patients—indicating a higher prevalence of smoking as a risk factor in the men than in the women referred for angiography. This finding is concordant with the results in a study by Darabian et al [19] among Iranians and also in a study by Habib et al [20] among Arab patients, whereas it runs contrary to the results obtained by Masoomi et al [21] and Bigi et al [22] among Iranian subjects.

Changes in the levels of lipoproteins—including increased levels of total cholesterol, triglycerides, and LDL-C, as well as reduced levels of HDL-C—are the other factors that affect cardiovascular diseases. In the current study, among the different lipid components, low HDL-C was the main indicator of CAD; this finding is consistent with the result reported by Sadeghi et al. [23] Likewise, Guo et al [24] showed that low HDL-C was a strong predicting factor of CAD and its severity. However, in our multivariate analysis, we eliminated the triggering effect of increased total cholesterol levels on CAD. In a study by Sukhija et al, [25] the association between increased levels of total cholesterol and CAD severity remained significant. Nonetheless, similar to our observation, this association was not revealed in an investigation by Zand Parsa et al. [26]

Of the non-modifiable risk factors for CAD, the role of advanced age is clear. In line with our findings, Hosseini et al [27] showed a higher prevalence rate of CAD and its severity in their older patients than in their younger counterparts. Similarly, in a study by Humphries and colleagues, [28] the average age was higher in those with abnormal angiography features. Kreatsoulas and colleagues [29] showed that the prevalence of artery stenosis or occlusion was different between their male and female study subjects, which is consistent with our results.

Our study had some potential limitations–including its cross-sectional design, which precluded a determination of time priority between the independent and dependent variables. Furthermore, the illegibility of some data extracted from the patients' medical files led to their exclusion from the analysis. In addition, the data on some confounding variables such as anthropometric indices were not available in the recorded files and were, thus, not considered for the analysis.

CONCLUSIONS

Among the different non-modifiable variables, gender, age, and a family history of CAD and among the modifiable variables, smoking, hypertension, and reduced HDL-C increased the risk for coronary involvement and should, thus, be regarded as the powerful triggers for coronary lesions such as occlusion. Further cohort studies and meta-analyses are required to clarify the causative association between these risk factors and coronary occlusion.

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Original Article

Assessment of the Relationship Between the HbA1c Level and Atherosclerosis Burden in Patients Undergoing Coronary Angiography in Farshchian Heart Center, Hamadan, Iran

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ABSTRACT

Background: Diabetes mellitus (DM) is a chronic disease which increases the risk of coronary artery disease (CAD). We sought to determine the relationship between the serum HbA1c level and the severity of CAD in diabetic patients.

Methods: This cross-sectional study enrolled 138 patients with DM who were candidated for selective coronary angiography. HbA1C was measured in all the patients. The study population's demographic information was collected through questionnaires. The data were analyzed with the SPSS software, version 16, and the descriptive statistical method was used to present the results.

Results: Selective coronary angiography was normal in 4.3% of the patients, while 26.1% had single-vessel disease, 47.8% had double-vessel disease, and 21.7% had triple-vessel disease. The serum HbA1c was less than 7% in 23.9%, between 7% and 9% in 39.1%, and more than 9% in 36.9% of the patients. A serum HbA1c level of more than 9% was reported in 42.1% of the patients with triple-vessel disease.

Conclusions: Our results indicated a relationship between the serum HbA1c level and the severity of CAD. ***(Iranian heart Journal 2018; 19(3): 46- 50)***

KEYWORDS: Coronary artery disease, Diabetes mellitus, HbA1c, Coronary angiography

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Diabetes mellitus (DM) is a term applied to a group of metabolic disorders which shares a phenotype of hyperglycemia. Various kinds of DM are developed by genetic and environmental factors, with the effective factors including decrement in insulin release, reduction in

glucose consumption, and increase in glucose production.

There are 2 major types of DM. In type I, a destruction of beta cells in the pancreas causes a defect in insulin production, and in type II, the body develops a progressive resistance to insulin, which finally causes a destruction of the pancreas beta cells and a complete defect in insulin production. In type II DM, genetic factors, obesity, and inactivity are considered the main causes.

DM causes end-stage renal disease, lower extremity non-traumatic amputation, blindness in adults, and cardiovascular diseases. With the rise in the incidence of DM in the world—reaching 382 million cases in 2013 from 30 million in 1985—it is expected to become the major cause of mortality in the future. The International Federation of Diabetes has predicted that the incidence of diabetes will amount to 592 million in 2035. Type II DM is more common than type I because of the increased rates of obesity and inactivity. In terms of the geographical distribution, type I diabetes is more common in Scandinavia and less frequent in the Pacific Ocean coasts. The Pacific Ocean islands, the Middle East, and the USA are the most common areas for type II DM.

The main cause of mortality among diabetic patients is cardiovascular disease (between 65% and 80% of all deaths). Individuals with DM are more at risk of cardiovascular disease and more likely to develop problems at a younger age. Diabetics also have a higher potential to develop silent ischemic heart disease: one-third of heart attacks in these patients occur with no known symptoms for this disease. [1] The prognosis is worse for diabetics with coronary artery disease (CAD) and a history of myocardial infarction (MI) than for healthy individuals. [1, 2]

A previous investigation on 110 diabetic patients found a direct relationship between the 2 factors of the serum HbA1c level and the duration of the development of DM and the severity of the involvement of the coronary arteries. [3] Another study on 196 individuals, comprised of 131 male and 65 female patients, concluded that the HbA1c rating system could be used as a simple method for predicting CAD. [4]

In light of the abovementioned evidence, we sought to determine the relationship between the serum HbA1c level and the severity of CAD in patients with DM.

METHODS

This cross-sectional study was conducted on 138 diabetic patients who were admitted for selective coronary angiography in Farshchian Heart Center, Hamadan, Iran, between June 2014 and May 2015.

Data were collected with a questionnaire containing questions about age, gender, the duration of DM, total cholesterol, HbA1c, smoking, blood pressure, and the number of involved coronary arteries according to selective coronary angiography.

All the statistical analyses were carried out with the SPSS software, version 16 (SPSS, Chicago, Illinois). The χ^2 test was employed for the comparison of the variables. The statistical hypothesis was 2-tailed, with a *P* value less than 0.05 considered statistically significant. The data were presented as means ± standard deviations (SDs) for the quantitative variables and frequencies and percentages for the qualitative variables.

RESULTS

The present cross-sectional study recruited 138 patients with DM, comprised of 78 (56%) males and 60 (44%) females at a mean age of 60.98±8.80 years. Thirty-nine (29%) patients were smokers. The mean cholesterol level was 192.19±18.65 mg/dL, the mean systolic blood pressure 134.37±14.25 mm Hg, and the mean development duration of DM 5.34±4.174 years. Apropos of the coronary artery involvement, 6

(4.3%) patients had none, 36 (26.1%) had single-vessel disease, 66 (47.8%) had double-vessel disease, and 30 (21.7%) had triple-vessel disease.

The serum HbA1c level was less than 7% in 33 (23.9%) patients, 45.5% of whom had single-vessel disease, 45.5% had double-vessel disease, and 9% had triple-vessel disease. The serum HbA1c level was between 7% and 9% in 34 (39.1%) patients, 5.6% of whom had no vessel involvement, 22.2% had single-vessel disease, 61.1% had double-vessel disease, and 11.1% had triple-vessel disease. The serum HbA1c level was over 9% in 51 (36.9%) patients, 5.9% of whom had no involved vessels, 17.6% had single-vessel disease, 35.3% had double-vessel disease, and 41.2% had triple-vessel disease.

As is depicted in Table 1 the frequency of the diabetic patients with triple-vessel disease was greater among those with a serum HbA1c level higher than 9% than that in the other groups; however, there was no significant difference in the HbA1c level regarding the number of involved vessels (*P*=0.089).

Table 1. Frequency distribution of the different levels of HbA1c according to the number of involved coronary artery vessels in the diabetic patients

Number of Involved Vessels	HbA1c Level		
	<7%	7%–9%	>9%
0	0	3(5.6)	3(5.9)
1	15(45.5)	12(22.2)	9(17.6)
2	15(45.5)	33(61.1)	18(35.3)
3	3(9)	6(11.1)	21(41.2)
Total	33(100)	54(100)	51(100)

Table 2 shows that 96 (69.5%) patients had the coronary involvement of at least 2 vessels on angiography. These subjects were significantly older and had a higher duration of DM than their counterparts. There were no significant differences between the groups vis-à-vis blood pressure, total cholesterol, gender, and smoking.

Table 2. Comparison between the diabetic patients in terms of the coronary involvement of a single vessel and the coronary involvement of at least 2 vessels

Variable	< 2 Vessels	≥ 2 Vessels	*P*
	Number (%)	Number (%)	
Age, y			
<60	21(40.4%)	31(59.6%)	0.048
≥60	21(24.4%)	65(75.6)	
Sex			
Male	27(34.6%)	51(65.4%)	0.224
Female	15(25%)	45(75%)	
Smoking			
Yes	66(66.7%)	33(33.3%)	0.238
No	30(76.9%)	9(23.1%)	
Diabetes duration			
<5	61(67%)	30(33%)	0.031
5-10	21(63.6%)	12(36.4%)	
>10	14(100%)	0(0)	
Cholesterol			
<200	15(35.7%)	27(28.1%)	0.373
≥200	27(64.3%)	69(71.9%)	
Blood pressure			
<140/90	51(70.8%)	21(29.2%)	0.735
≥140/90	45(68.2%)	21(31.8%)	

DISCUSSION

The HbA_1c level is one of the most important items in diabetic patients when it comes to controlling blood glucose and treating cardiovascular disease. [3-5] A relationship has been previously demonstrated between the HbA_1c level and the severity of coronary artery involvement in diabetic patients; therefore, HbA_1c can be used as a predictor of the cardiac side effects caused by DM. Patel et al [5] reported that their patients with serum HbA_1c levels of more than 9% had more triple-vessel involvement than their other patients.

According to our findings, the diabetic patients with the involvement of 2 or 3 coronary vessels on angiography were significantly older than their counterparts. This result, however, has not been reported by other studies. [6, 7]

In their study, al-Nozha et al [8] found that their diabetic female patients had a higher incidence of cardiovascular disease. Rivera and colleagues [9] reported that the severity of coronary artery involvement was less among their nondiabetic female patients than in their

male counterparts. In contrast, we and Saleem et al [3] found no significant statistical relationship between gender and the severity of coronary artery involvement in diabetic patients.

In the current study, the findings concerning the relationship between smoking and the severity of the involvement of the coronary arteries are concordant with those reported by Ashraf et al, [7] Ertem et al, [10] and Rasoul et al., [11] who reported no relationship in this regard.

Saleem et al [3] and Singer et al [12] reported a relationship between the duration of DM and the severity of coronary artery involvement. According to our study, the number of involved coronary arteries increased in tandem with an increase in the development duration of DM. All the patients with a more than 10-year history of DM development in the current study had double- or triple-vessel involvement on selective coronary angiography. Hence, the duration of DM development can be deemed an effective factor with respect to the severity of coronary artery involvement. [12]

In their respective studies, Saleem et al [3] and Ayhan et al [13] found no relationship between the total cholesterol level and the severity of the involvement of the coronary arteries. These findings do not chime in with the results of some other investigations, however. This discrepancy is probably due to the potent impact of DM on triglycerides and high-density lipoproteins compared with total cholesterol.

Our results showed no statistically significant relationship between blood pressure and the severity of coronary artery involvement, which does not tally with the results of a study by Karki et al. [6]

Overall, given the significance of the DM-related cardiovascular disease and its resultant morbidity and mortality, more attention should be paid to the control and prevention of DM. Our results underscored the role of HbA1c as an independent factor in predicting cardiovascular disease insofar as triple-vessel disease on selective coronary angiography was more frequent in our patients whose HbA1c levels exceeded 9%.

Conflict of Interest

The present study was supported by the Ethics Committee of the Medical Faculty of Hamadan University of Medical Sciences. All the contributing authors declare no conflict of interest.

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Iranian Heart Journal; 2018; 19 (3)

Original Article

Which Suction Method is Preferable for Patients After Cardiac Surgery: Open or Closed Endotracheal Suction System?

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ABSTRACT

Background: There are 2 different methods of suctioning the airway: the open tracheal suction system (OTSS) and the closed tracheal suction system (CTSS). The aim of this study was to compare the efficacy of the OTSS and the CTSS in maintaining the stability of hemodynamic and oxygen parameters in patients after cardiac surgery.

Methods: This randomized controlled clinical trial was conducted on 60 patients who were under mechanical ventilation after cardiac surgery. The study population was randomly divided into the OTSS and CTSS groups. All the patients were at least 18 years old and hemodynamically stable. Hemodynamic parameters such as systolic and diastolic blood pressures were measured. Oxygen parameters such as the saturation percentage of arterial blood oxygen (SpO_2) and the oxygen pressure of arterial blood (PaO_2) were measured before, immediately, and also 3 and 5 minutes after suction. All the parameters were compared between the 2 groups.

Results: The mean heart rate, the mean systolic blood pressure, and the mean arterial blood pressure showed a higher increase in the OTSS group ($P<0.05$), whereas the mean PaO_2 and SpO_2 were higher in the CTSS group ($P<0.05$).

Conclusions: The CTSS caused fewer disturbances in the hemodynamic and oxygen parameters in comparison with the OTSS in our study population. Therefore, disturbances in the aforementioned parameters can be avoided by using the CTSS in patients undergoing cardiac surgery. ***(Iranian heart Journal 2018; 19(3): 51- 59)***

KEYWORDS: Airway management, Suction, Cardiac surgical procedures, Hemodynamics

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Cardiovascular disease is the main cause of mortality all over the world. Aging, obesity, and an increase in the prevalence of hypertension and diabetes mellitus are the main reasons for the high rates of cardiovascular disease. [1] In the Iranian population, coronary artery disease is the leading cause of mortality and morbidity, and the cost of treatment and medical care is high. [2] There are currently 2 strategies to approach patients suffering from ischemic heart disease: coronary artery bypass grafting (CABG) and percutaneous coronary intervention. [3, 4] The selection of the appropriate method is based on the patient's angiographic features and clinical condition, as well as the treating physician's discretion. [5, 6] Cardiac surgery may be indicated in patients with valvular diseases, congenital heart disease, or heart transplantation. [7] These patients need general anesthesia and mechanical ventilation during surgery. [8] The suctioning of the airway secretions is extremely important for intubated patients in that it enhances the quality of respiration, improves oxygenation, and prevents the airway obstruction by the secretions. Another advantage of suctioning is that it can protect the respiratory tract against infections. [9-15] In the intensive care unit (ICU), airway suctioning is possible via 2 methods: the open tracheal suction system (OTSS) and the closed tracheal suction system (CTSS). In the OTSS, ventilation should be discontinued during suctioning, while the CTSS obviates the need to disconnect the patient from the ventilator and ventilation can be continued during suctioning. [16] The OTSS is applied frequently, but it may cause such complications as increased chances of atelectasis, decreased respiratory volumes and oxygenation, and ultimately hypoxemia. [17] The CTSS appears to be more suitable for patients inasmuch as it can reduce the incidence of nosocomial pneumonia, [18] the rate of aspiration and hypoxemia, [19] and the incidence of contamination with the patient's respiratory secretions. [20]

Several studies have shown the superiority of the CTSS over the OTSS. [17-20] Nonetheless, these results should be interpreted in light of the unavoidable differences in the underlying conditions of different patients in different hospitals. Accordingly, we conducted the present study in Rajaie Cardiovascular, Medical, and Research Center on a sample of Iranian patients who undergo cardiac surgery so as to compare the efficacy of the CTSS and the OTSS. Before the study, the OTSS was the preferred method of suctioning among patients after cardiac surgery in our hospital and an important purpose of this study was to demonstrate the benefits of the CTSS in order to generalize its use.

METHODS

The present randomized controlled clinical trial was conducted on 60 patients admitted to the Cardiac Surgery Ward of Rajaie Cardiovascular, Medical, and Research Center—a cardiovascular tertiary care hospital in Tehran, Iran—between October and December 2016. The study protocol was approved by the institutional ethics committee. After providing the patients with thorough explanations about the study, informed written consent for participation was obtained from them. The inclusion criteria comprised a minimum age of 18 years, elective cardiac surgery (including CABG and heart valve surgery), stable hemodynamics, a peripheral capillary oxygen saturation (SpO_2) level of more than 80%, the absence of any severe lung disease, and the absence of any serious arrhythmias.

Via balanced block randomization techniques, the patients were randomly assigned to 2 groups of the OTSS and the CTSS. The study was open-label. The data collected prior to surgery encompassed the demographic characteristics, chronic underlying diseases,

and the prescribed drugs. All the patients were admitted to the ICU after cardiac surgery and underwent mechanical ventilation.

The study endpoints were classified into 2 groups: the hemodynamic parameters and the oxygen parameters. The hemodynamic parameters were comprised of the heart rate, blood pressure, and the mean arterial blood pressure. The mean arterial blood pressure was measured invasively with a Spacelabs transducer and a bedside Spacelabs ELO monitor from the left radial artery line. The oxygen parameters consisted of SpO_2, the oxygen pressure of arterial blood (PaO_2), the partial pressure of carbon dioxide ($PaCO_2$), the acidity of arterial blood (pH), the alveolar–arterial oxygen gradient ($AaDO_2$), and the ratio of the arterial blood pressure to the percentage of inspired oxygen. These parameters (except for pH) were considered the primary endpoints of the study.

A Techno Medica GASTAT-603ie was used to analyze the levels of SpO_2, PaO_2, $PaCO_2$, and pH. $AaDO_2$ and the ratio of the arterial blood pressure to the percentage of inspired oxygen were calculated and recorded according to the related formulae. The data on the hemodynamic and oxygen parameters were collected 1 hour after surgery in the ICU. The parameters were recorded before, immediately after, and 3 and 5 minutes following the 2 methods of airway suctioning.

The data were described as means ± standard deviations for the interval variables with normal distributions and counts (%) for the categorical variables. The fitness of the distribution of the interval variables to a normal distribution was assessed with the one-sample Kolmogorov–Smirnov test. The associations between the suctioning type and the other variables were determined with the Student *t*-test for the interval variables and the Pearson χ^2 test or the Fisher exact test, as needed, for the nominal variables. Repeated-measure analysis of variance (ANOVA) models were used for the assessment of the variations in the interval variables over time. A *P* value equal to or less than 0.05 was considered statistically significant. The statistical analyses were carried out with the IBM SPSS Statistics, version 19, for Windows (IBM Inc, Armonk, NY).

RESULTS

The study population was comprised of 60 patients: 23 (38.8%) women and 37 (61.7%) men at a mean age of 54±15.8 years (19–83 y). The participants' baseline characteristics were compared between the 2 study groups, and the results are presented in Table 1. There were no significant differences in terms of the basic data between the CTSS and the OTSS groups (*P*>0.05).

The information about the surgical procedures and medication usage is presented in Table 2, which shows the similarity between the 2 study groups (all *Ps*>0.05).

Table 1. Comparisons of the baseline data before surgery between the 2 groups

	Open Suction (n=30)	Closed Suction (n=30)	*P*
age	50 ± 16.2	58± 14.5	0.207
Sex (F/M)	12/18	11/19	0.791
BMI (kg/m^2)	25.8± 5	25.7±3.6	0.46
Smoking	4 (13.3%)	5 (16.7%)	0.718
Hyperlipidemia	8 (26.7%)	11 (36.7%)	0.405
Hypertension	10 (33.3%)	14 (46.7%)	0.292
Diabetes mellitus	8 (26.7%)	3 (10%)	0.095
Hemoglobin (g/dL)	10.11 ± 0.89	10.1 ± 1.24	0.138
LVEF (%)	46.2± 7.39	46.5 ± 7.44	0.828

BMI, Body mass index; LVEF, Left ventricular ejection fraction

Table 2. Comparisons of the surgery data between the 2 study groups

	Open Suction (n=30)	Closed Suction (n=30)	*P*
Type of Surgery			
CABG	13 (43.3%)	19 (63.3%)	0.121
Heart valve surgery	17 (56.7%)	13 (43.3%)	0.302
Other surgeries	5 (16.7%)	1 (3.3%)	0.085
Serum transfusion (mL)	1850 ± 570	1730 ± 480	0.920
Pump time (min)	102.5 ± 39.5	87.5 ± 29.1	0.226
Drugs			
Inotropic agent use	9 (30%)	12 (40%)	0.417
Inotrope Dose			0.487
Low dose	8(26.7%)	12 (40%)	
High dose	1(3.3%)	0	
Epinephrine	9 (30%)	7 (23.3%)	0.559
Norepinephrine	1 (3.3%)	2 (6.7%)	0.0554
Milrinone	2 (6.7%)	3 (10%)	0.642
Low-dose nitroglycerin	18 (60%)	19 (63.3%)	0.196

CABG, Coronary artery bypass grafting

The results of the study outcomes are presented in Table 3, 4. The findings were as follows:

Systolic blood pressure: Systolic blood pressure rose after airway suctioning and then dropped gradually. The maximum systolic blood pressure was detected just after suctioning in the 2 groups. Significant differences were detected in all the post-suctioning stages in the OTSS group in comparison with the CTSS group (Table 3). The *P* values for both the main effect of time and the interaction between time and groups were less than 0.001, which means that the CTSS maintained systolic blood pressure lower and with less variability over time than the OTSS.

Table 3. Comparisons of blood pressure and the heart rate between the 2 study groups

	Open Suction (n=30)	Closed Suction (n=30)	*P*
Systolic Blood Pressure (mm Hg)			
Baseline	111 ± 13.7	115 ± 11.2	0.232
Just after suction	134 ± 12.4	118 ± 10.5	<0.001
3 min after suction	127 ± 15	116 ± 9.6	0.001
5 min after suction	120 ± 13.9	113 ± 10.3	0.021
Diastolic Blood Pressure (mm Hg)			
Baseline	65 ± 11.8	64 ± 8.6	0.690
Just after suction	79 ± 10.8	66 ± 8.2	<0.001
3 min after suction	75 ± 12	64 ± 7.8	<0.001
5 min after suction	70 ± 11.5	63 ± 8	0.004
Mean Arterial Pressure (mm Hg)			
Baseline	95 ± 12.4	98 ± 9.6	0.378
Just after suction	115 ± 11.7	101 ± 9	<0.001
3 min after suction	109 ± 13.6	99 ± 8.1	0.001
5 min after suction	103 ± 12.9	96 ± 8.7	0.015
Heart Rate (beat/ min)			
Baseline	89 ± 13.1	91 ± 17.3	0.604
Just after suction	111 ± 12.4	93 ± 17.1	<0.001
3 min after suction	104 ± 13.9	92 ± 17.1	0.005
5 min after suction	96 ± 15.3	90 ± 17.4	0.166

Diastolic blood pressure: Diastolic blood pressure increased following airway suctioning and subsequently decreased gradually. Again, significant changes were detected after suctioning (Table 3). Similar to systolic blood pressure, there was a significant interaction

insofar as diastolic blood pressure was more stable with the CTSS than with the OTSS.

Mean arterial blood pressure: The mean arterial pressure rose after suctioning and then decreased steadily. The changes were significant in all the stages following suctioning, and they were higher in the OTSS group (Table 3).

Heart rate: The heart rate initially rose after airway suctioning before it exhibited a gradual fall. The maximum heart rate was detected just after suctioning in the 2 groups. The rise was significant in the OTSS group by comparison with the CTSS group, just after airway suctioning (Table 3). The *P* values for both the main effect of time and the interaction between time and groups were less than 0.001, which suggests the considerable superiority of the CTSS over the OTSS.

PaO_2: The pressure of oxygen declined after airway suctioning but subsequently rose gradually. The reduction was significant just after suctioning, and the pressure of oxygen declined more in the OTSS group than in the CTSS group (Table 4). The repeated-measure ANOVA revealed the significant main effect of time and the interaction between time and groups ($P<0.001$).

PaCO2: There was a significant change in the 2 groups following airway suctioning but not 5 minutes after suctioning (Table 4). There was an interaction between time and groups, which denotes different changing patterns in the study groups ($P=0.006$).

Oxygen saturation: After airway suctioning, oxygen saturation declined more in the OTSS group than in the CTSS group (Table 4).

Table 4. Comparisons of the oxygen parameters between the 2 study groups

	Open Suction (n=30)	Closed Suction (n=30)	*P*
Partial Pressure of O_2 (mm Hg)			
Baseline	218 ± 62	212 ± 57.2	0.697
Just after suction	179 ± 63.5	170 ± 50.4	0.540
3 min after suction	121 ± 41.7	166 ± 61.8	0.001
5 min after suction	141 ± 56.4	172 ± 57	0.037
Partial Pressure of Carbon Dioxide (mm Hg)			
Baseline	30 ± 5.6	31 ± 5.1	0.531
Just after suction	34 ± 4.9	35 ± 5.8	0.665
3 min after suction	37 ± 6.2	34 ± 5.9	0.096
5 min after suction	35 ± 4.9	34 ± 5.8	0.521
pH (mol/L)			
Baseline	7 ± 0.1	7 ± 0.1	0.474
Just after suction	7 ± 0.1	7 ± 0.1	0.456
3 min after suction	7 ± 0.1	7 ± 0.1	0.983
5 min after suction	7 ± 0.1	7 ± 0.1	.767
Alveolar–Arterial O_2 Gradient (mm Hg)			
Baseline	102 ± 59.9	107 ± 53.6	0.737
Just after suction	135 ± 62.4	143 ± 49.7	0.567
3 min after suction	190 ± 41.5	148 ± 59.6	0.002
5 min after suction	172 ± 55.8	142 ± 55.4	0.041
PaO_2/FiO_2 ratio (mm Hg)			
Baseline	435 ± 124.1	423 ± 114.5	0.697
Just after suction	357 ± 127.1	339 ± 100.8	0.540
3 min after suction	241 ± 83.4	332 ± 123.7	0.001
5 min after suction	281 ± 112.7	344 ± 114	0.037
O_2 Saturation (%)			
Baseline	100 ± 0.7	100 ± 0.8	0.606
Just after suction	99 ± 1.3	99 ± 1.8	0.412
3 min after suction	88 ± 3.3	98 ± 1.6	<0.001
5 min after suction	93 ± 2.8	98 ± 1.1	<0.001

pH: pH did not have any significant changes in the 2 groups after suctioning. The *P* value for interaction was not significant.

$AaDO_2$: The increase of this index was higher in the OTSS group just after airway suctioning. As is shown in Table 4, the pattern of the changes of the gradient in the OTSS was different from that of the CTSS ($P<0.001$ for interaction).

PaO_2/FiO_2 ratio: There was a decrease in this ratio just after airway suctioning, with the change being more pronounced and significant in the OTSS group (Table 4). Similar to the previous index, the changing pattern was different between the OTSS and the CTSS ($P<0.001$ for interaction).

DISCUSSION

Based on the results of the present study, the post-cardiac surgery use of the CTSS—in comparison with the OTSS—conferred stabilization in the hemodynamic and oxygen parameters. It, therefore, appears that the CTSS it is safer and more suitable for patients after cardiac surgery.

In the current study, the mean heart rate initially rose after airway suctioning and then declined in the OTSS and CTSS groups, but the changes were less pronounced in the CTSS group and were significant just after the suctioning of the airway ($P=0.04$). Several studies have reported similar results. Bourgault et al [21] reported an increase in the heart rate in their study population, with the change being significant with the OTSS in comparison with the CTSS ($P<0.05$). Lee and coworkers [22] also found a rise in the heart rate with the OTSS, which was significant just after airway suctioning ($P<0.05$). Valderas and colleagues [23] reported no significant differences between the CTSS and the OTSS.

Our patients' systolic blood pressure increased during airway suctioning and then decreased afterward, and the changes were significant in all the post-suctioning stages ($P<0.05$). Furthermore, there was more stability in this regard with the CTSS than with the OTSS. This finding was in line with the results reported by Nazmieh et al [24] and Zolfaghari and coworkers. [25]

We found no significant difference with respect to diastolic blood pressure between the OTSS and CTSS groups. Zolfaghari et al [25] demonstrated a significant difference in diastolic blood pressure in that the rise was more significant in their OTSS group than in their CTSS group ($P<0.05$).

In the present study, the mean arterial pressure initially increased and then gradually decreased in both OTSS and CTSS groups, but the changes were less remarkable in the latter group and were significant in all the post-suctioning stages ($P<0.05$). Zolfaghari and colleagues [25] showed similar results, whereas Mohammadpour et al [26] found no significant difference between the OTSS and CTSS groups. Nazmieh and coworkers [24] reported a rise in the mean arterial rate in their CTSS group a minute after airway suctioning.

In both of our study groups, PaO_2 decreased after the suctioning of the airway and then had a gradual increase; the reduction, however, constituted statistical significance in the OTSS group ($P=0.018$). Accordingly, the OTSS may have a higher efficacy in decreasing the pressure of oxygen. This finding is concordant with the result reported in a study by Lasocki et al.[27]

According to our results, the change in $PaCO_2$ was not significant in any stages after airway suctioning in both groups ($P>0.05$). Nazmieh et al [24] reported that $PaCO_2$ decreased significantly with the CTSS in comparison with the OTSS.

Oxygen saturation decreased after the suctioning of the airway in both of our study groups. The reduction was significant in all the stages ($P<0.05$), and it was more stable in the

OTSS group. Seyed Mazhari et al [24] and Nazmieh and colleagues [28] reported similar results.

In our study, the change in pH was not significant in any stages after airway suctioning (P<0.05), which chimes in with the result reported by Özden et al. [29]

The $AaDO_2$ gradient initially rose after airway suctioning and then dropped gradually in both of our study groups. The increase was higher in the OTSS group, and the changes were significant just after the suctioning of the airway (P=0.039). This result is similar to that reported in a study by Copnell et al. [30]

According to our findings, the PaO_2/FiO_2 ratio decreased after airway suctioning and increased gradually afterward. The reduction was more pronounced in the OTSS group, with the change constituting statistical significance (P=0.018). In contrast, in the study by Copnell et al, [30] no difference was observed between the 2 groups.

We found that the changes in the hemodynamic and oxygen parameters were less pronounced in the CTSS group. Given the importance of the stabilization of patients following cardiac surgery, the CTSS appears to be more suitable in this group of patients inasmuch as these parameters are subjected to fewer disturbances with this method.

First and foremost among the limitations of the present study is that while with the OTSS it was possible to suction the trachea and the mouth simultaneously, suctioning the mouth was not possible with the CTSS. Another drawback of note is that our nurses had more experience with the OTSS than with the CTSS and they generally preferred the former. Given that the CTSS is especially useful in unstable patients or those who are suffering from oxygenation problems (eg, hypoxemia), we would recommend that new training programs be devised for nurses in the ICU, as well as for medical students, with an emphasis on the use of the CTSS.

CONCLUSIONS

In the immediate post-cardiac surgery period, it is of vital importance that the patient be stabilized and hypoxia be prevented. In light of the results of the present study, it appears that the CTSS causes fewer disturbances in the hemodynamic and oxygen parameters than the OTSS.

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Iranian Heart Journal; 2018; 19 (3)

Original Article

Registry Study of Patients Who Needed Emergent Surgery due to Complications of Cardiac Catheterization in Rajaie Heart Center Between 2005 and 2015

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ABSTRACT

Background: Coronary artery disease is the leading cause of death in most societies today. One of the most important diagnostic and therapeutic methods used in this field is cardiac catheterization. This procedure is, however, invasive and can lead to cardiac complications, vascular complications, and even death.

Methods: In this study, we reviewed the characteristics of adolescent patients who needed emergent surgery due to catheterization complications between 2005 and 2015 at Rajaie Cardiovascular, Medical, and Research Center, Tehran, Iran. This study was done descriptively. Of 1028 patients transferred to the operating room in the first 24 hours after catheterization, a total of 36 patients needed emergent surgery due to catheterization complications. The data of these patients were extracted from the archives and analyzed using the SPSS software.

Results: Acute mitral valve regurgitation post percutaneous transmitral commissurotomy occurred in 8 (22%) patients, vascular rupture and retroperitoneal hematoma in 8 (22%), rupture of the cardiac chambers and tamponade in 5 (14%), coronary artery dissection in 4 (11%), vascular access thrombosis in 3 (8%), vascular access dissection in 3 (8%), embolization and malposition of the Amplatzer device in 2 (6%), clot formation on the Amplatzer device in 1 (3%), cardiac arrest in 1 (3%), and vascular sheath fracture in 1 (3%). Of the 36 patients, 6 died.

Conclusions: A comparison of the incidence rates of post-cardiac catheterization complications leading to emergent surgery between our center and other similar centers shows no significant difference. ***(Iranian heart Journal 2018; 19(3): 60- 63)***

KEYWORDS: Cardiac catheterization, Complication, Emergent surgery

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Coronary artery disease is the leading cause of death in most societies today, accounting for 70% of deaths in individuals over 75 years of age and 25% of mortalities in individuals aged over 30 years. [1-3] One of the important diagnostic and therapeutic methods used in this field is cardiac catheterization. Cardiac catheterization is, however, an invasive method with a reported mortality rate of 0.1%. [4,5] The most important complications of cardiac catheterization are arrhythmias, hematomas, pseudoaneurysms, vascular access bleeding, cardiac chamber perforation and tamponade, aortic dissection, and arterial embolism. Some of these complications require emergent surgery. [6-9] Rajaie Cardiovascular, Medical, and Research Center in Tehran is the largest research and treatment center for cardiovascular diseases in Iran and has served as a pioneer in modern cardiovascular disease treatment for over 30 years. Given the dearth of systematic research in our country on post-cardiac catheterization complications, we sought to review the characteristics of adolescent patients who needed emergent surgery due to such complications between the years 2005 and 2015 in our hospital.

METHODS

In this descriptive study based on cardiac catheterization and surgical reports, from a total of 1028 patients with a 24-hour interval between catheterization and surgery, 36 patients who needed emergent surgery due to post-cardiac catheterization complications were selected. The data were extracted through the archival records of the patients and were analyzed using the SPSS software, version 16.

RESULTS

In this study, 36 patients at an average age of 45.1 years and a standard deviation of 18.3 were included. Twenty-three (64%) patients were female and 13 (36%) male. The mean ejection fraction in the study population was 48.2%, with a standard deviation of 6.9%. With respect to the prevalence of cardiovascular risk factors, hypertension was reported in 32.7% of the study patients, chronic kidney disease in 2.7%, and diabetes mellitus 16.2%. Table 1 depicts the prevalence of the types of the cardiac catheterization procedures.

Table 1. Prevalence of the procedure types

Procedure Type	10 Years' Prevalence	Number of Procedures Leading to Major Complications	Percentage
PTMC	1444	12	0.85
Coronary angiography	55647	5	0.009
Elective PCI	20155	4	0.02
Peripheral angioplasty	1300	4	0.3
Coarctoplasty	374	4	1.1
ASD device closure	503	2	0.4
Primary PCI	2252	1	0.04
PTPC	179	1	0.57
Pericardiocentesis	235	1	0.4
RHC in CHD	3743	1	0.02

PTMC, Percutaneous transcatheter mitral commissurotomy; PCI, Percutaneous coronary intervention; ASD, Atrial septal defect; PTPC, Percutaneous transcatheter pulmonary commissurotomy; RHC, Right-heart catheterization; CHD, Congenital heart disease

One patient with hypertrophic obstructive cardiomyopathy had alcohol septal ablation; however, the procedure was complicated with cardiac arrest. After resuscitation, the patient was transferred to the operating room for the implantation of extracorporeal membrane oxygenation.

Overall, 95% of the procedures were done electively and 2 (5%) cases were done emergently. Thirty-four procedures were done on the morning shift, 1 procedure on the evening shift, and 1 procedure on the night shift.

The frequency of the complications is presented in Table 2.

Among the 36 patients, 6 deaths occurred (all at the same admission) and the other patients were alive at 6 months' follow-up. The characteristics of these patients are presented in Table 3 based on the type of the procedures and the type of the complications.

Table 2. Prevalence of the complications

Complication	Prevalence	Percentage
Post-PTMC acute severe mitral regurgitation	8	22
Vascular rupture and hematoma	8	22
Chamber perforation and tamponade	5	14
Coronary artery dissection	4	11
Vascular access thrombosis	3	8
Dissection of the vascular access	3	8
Device embolization/malposition	2	6
Clot formation on the closure of the device	1	3
Cardiac arrest	1	3
Vascular sheath fracture	1	3
Total	36	100

PTMC, Percutaneous transcatheter mitral commissurotomy

Table 3. Procedures and complications leading to death

Procedure	Complication	Prevalence	Percentage
Peripheral angioplasty	Dissection of great artery	2	33.6
Alcohol septal ablation	Arrhythmia	1	16.6
RHC in CHD	Vascular rupture and hematoma	1	16.6
PTMC	Chamber perforation and tamponade	1	16.6
Elective PCI		1	16.6
Total		6	100

PTMC, Percutaneous transcatheter mitral commissurotomy; PCI, Percutaneous coronary intervention; RHC, Right-heart catheterization; CHD, Congenital heart disease

There were 2 pregnant women with severe mitral stenosis and dyspnea (functional class IV) resistant to medical treatment. These women underwent percutaneous transcatheter balloon valvuloplasty. One of them was transferred to the operating room due to left atrial perforation and tamponade for pericardiocentesis. After pericardiocentesis, no bad outcome threatened the mother and the fetus, and the patient was discharged with a good outcome. The other pregnant patient was transferred to the operating room for mitral valve replacement to treat acute mitral regurgitation. The patient's fetus suffered intrauterine death on the first postoperative day, but the mother was discharged in a stable condition.

In 2005, Chessa et al [10] evaluated 417 patients with atrial septal defect device closure and reported that 10 (2.4%) patients were in need of emergent surgery due to device displacement. In our study, of 503 cases of the device closure of atrial septal defects, 2 (0.4%) patients required emergent surgery.

In 2005, Praveen et al [11] reported that out of a total of 1388 cases of percutaneous transcatheter mitral commissurotomy (PTMC), 31 (2.2%) patients required emergent surgery: 23 (74.2%) due to acute mitral regurgitation and 8 (25.8%) due to tamponade. In our study, out of 1444 patients with PTMC, 12 (0.8%) cases needed emergent surgery: 8 (66.7%) due to acute mitral regurgitation and 4 (33.3%) due to tamponade.

In a study conducted by Molaei et al [12] in the pediatric ward of our center, only 1 (3.8%) patient from a total of 26 patients who had undergone transient catheter coarctoplasty developed major complications. In our study, of 374 patients who underwent this procedure, only 4 cases (1.1%) needed emergent surgery.

CONCLUSIONS

A comparison between the previous articles and our study shows no significant difference between our center and its counterparts in terms of the incidence of post-cardiac catheterization complications. Nonetheless, we encountered problems regarding data collection, which can be overcome with the implementation of a catheterization complications registry system in our cath-lab service.

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Case Report

Emergency Surgical Treatment for the Total Occlusion of the Left Main Coronary Artery: A Case Report

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ABSTRACT

Background: The acute occlusion of the left main coronary artery (LMCA) in the absence of the collateral circulation is extremely rare, but it remains a catastrophic and mostly fatal entity due to myocardial infarction with severe cardiogenic shock and arrhythmias.

Methods: We evaluated 2 patients with an acute or acutely evolving occlusion of the LMCA undergoing coronary artery bypass grafting (CABG).

Results: The in-hospital mortality rate was 50%. Revascularization was achieved with on-pump CABG in both patients.

Conclusions: The total occlusion of the LMCA represents a unique clinical condition. The LMCA occlusion with shock is regarded as a class I_A indication for acute surgical revascularization. Nonetheless, emergent percutaneous coronary intervention (PCI) may be an effective method to acutely revascularize these patients. Additionally, aggressive post-PCI care—including intra-aortic balloon pumps, extracorporeal membrane oxygenation, CABG, and ventricular support devices—may be required to improve patient survival. ***(Iranian heart Journal 2018; 19(3): 64- 67)***

KEYWORDS: Left main coronary artery obstruction, Myocardial infarction, Cardiogenic shock, Early revascularization, Coronary artery bypass surgery

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The total occlusion of the left main coronary artery (LMCA) due to atherosclerosis is an unusual entity. [1] The significant disease (>50% narrowing) of the LMCA has been reported in about 5% of patients undergoing coronary arteriography, while the prevalence of the total LMCA occlusion is between 0.04% and 0.067% in patients undergoing angiography [1, 2] and 0.76% in patients undergoing revascularization

surgery. [3] The total LMCA occlusion can be either acute or chronic, [8] and its prognostic determinants are dependent on coexisting intercollaterals, a dominant right coronary artery (RCA), and the rapid establishment of complete reperfusion. [5]

We herein describe 2 surgically treated patients who survived the total LMCA occlusion, which appeared to have been acute or acutely evolving.

CASE PRESENTATION

Case 1

An 80-year-old man was admitted to our hospital with severe chest pain of 5 hours' duration. The patient's risk factors for atherosclerotic heart disease included an adult onset of diabetes mellitus, which was controlled with medical treatment. The physical examination revealed a blood pressure of 88/63 mm Hg and a pulse rate of 51 beats per minute. The electrocardiogram (ECG) showed ST-segment depression in the inferolateral leads. A bedside transthoracic echocardiographic examination showed akinetic apex and septum without significant valvular pathology and with a left ventricular ejection fraction of 40%. The chest X-ray and routine laboratory tests were normal. In particular, the initial quantitative troponin test and the MB creatine kinase level (14 ng/mL) were normal on admission. However, within a 3-hour period, the patient's angina pectoris continued and he developed symptoms and signs of cardiogenic shock. The ECG revealed ST-segment elevations in the aVL, aVR, V_1, and V_2. As a result, he was administered 300 mg of oral aspirin (chewed) and 600 mg of oral clopidogrel just prior to angiography.

Coronary angiography was performed immediately via the Judkins technique. It demonstrated the total occlusion of the proximal LMCA with no antegrade filling. The RCA was dominant and normal. There was no retrograde filling of both the left anterior descending artery (LAD) and the left circumflex (LC_X) systems from the RCA. These angiographic findings did not tally with the patient's symptoms (Fig. 1 and 2).

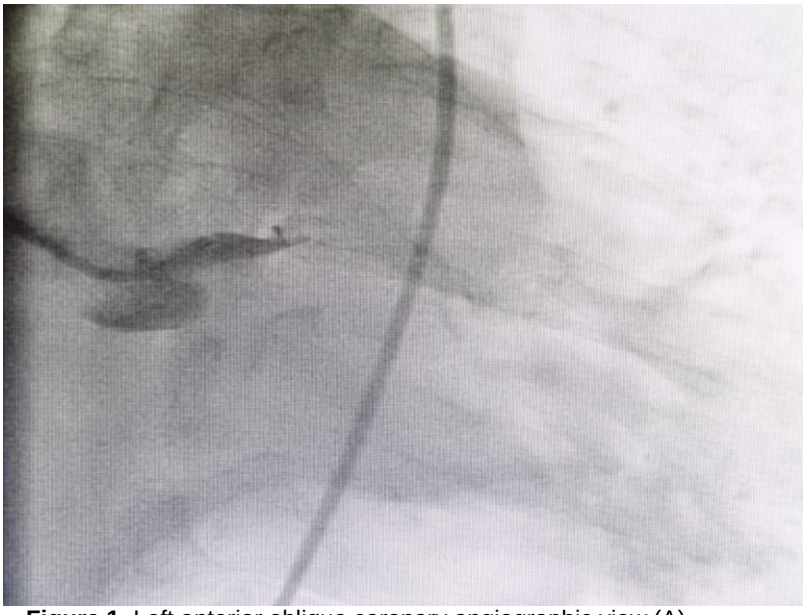

Figure 1. Left anterior oblique coronary angiographic view (A), showing the total occlusion of the proximal left main coronary artery with no antegrade filling

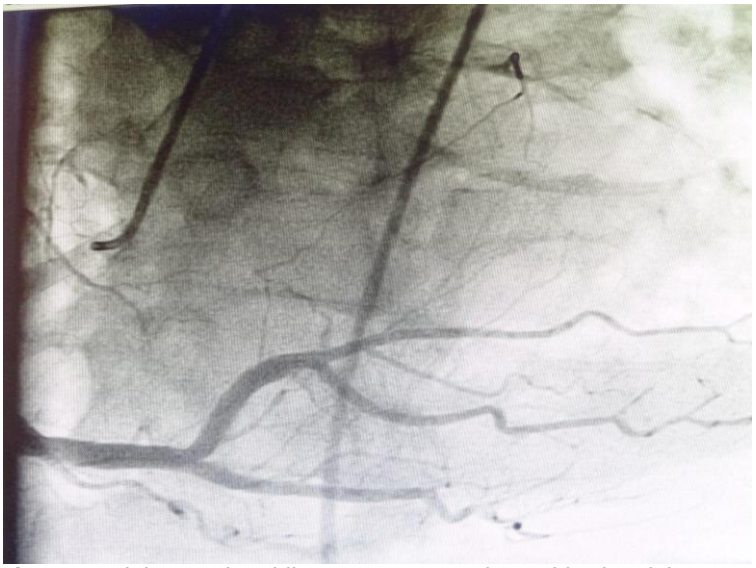

Figure 2. Right anterior oblique coronary angiographic view (A), showing that the right coronary artery is dominant and normal with collateral arteries

After catheterization, the patient was taken immediately to the operating room, where 2 bypass grafts were placed. CABG was performed with cardiopulmonary bypass machine support (on-pump). The left internal descending artery was anastomosed to the LAD and a saphenous vein graft was anastomosed to the LC_X. Antegrade and retrograde cardioplegia was used for a better myocardial protection. The patient's postoperative course was difficult, and he needed inotropic support and an intra-aortic balloon pump (IABP) for the first 72 hours. At about 3 months postoperatively, he was asymptomatic and still taking medications.

Case 2

A 52-year-old man was admitted to our cardiac service with severe angina of 4 hours' duration and a loss of consciousness (obtundation). The patient had no risk factors for atherosclerotic heart disease in his medical history.

The physical examination revealed a blood pressure of 83/60 mm Hg and a pulse rate of 130 beats per minute. The ECG showed ST-segment and T-wave changes in the leads I, aVL, and V_{1-4}, which represented an acute anterolateral myocardial infarction. A bedside echocardiographic examination showed severe akinesia in the anterior wall, apex, and septum with a moderate mitral regurgitation and a left ventricular ejection fraction of about 10%. The routine laboratory tests were normal. The initial troponin test and the MB creatine kinase level were elevated on admission.

With a diagnosis of cardiogenic shock, the patient was administered 300 mg of oral aspirin (chewed) and 600 mg of oral clopidogrel just prior to percutaneous coronary intervention (PCI).

An IABP was inserted in the femoral artery for hemodynamic support. Coronary angiography was performed immediately, and it demonstrated the total occlusion of the proximal LMCA with no antegrade filling. The RCA was dominant and had a distal significant lesion. There was no retrograde filling of both the LAD and LC_X systems from the RCA. The angiographic findings did not match the patient's symptoms. After catheterization, he was transferred immediately to the operating room, where 3 bypass grafts were placed. CABG was performed with cardiopulmonary bypass machine support (on-pump). A saphenous vein graft was anastomosed to the LAD, the LC_X, and the RCA. Antegrade and retrograde cardioplegia was used for a better myocardial protection. The patient's postoperative course was difficult, and he

needed inotropic support and an IABP. Eventually, he died with symptoms of the low cardiac output syndrome 48 hours after the operation.

CONCLUSIONS

The total occlusion of the LMCA represents a unique clinical condition, the development of which is attributed to certain acute and chronic pathologic processes or to iatrogenic factors relating to mechanical manipulations in the LMCA. The symptoms correspond to the presence and the quality of the collateral vessels, associated myocardial damage, and impaired hemodynamics. Although emergent PCI may be an effective method to acutely revascularize this subset of patients, aggressive post-PCI care—including IABPs, extracorporeal membrane oxygenation, CABG, and ventricular support devices—may be required to enhance patient survival.

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(181) Case Report

Metastatic Cardiac Mass: Role of Transthoracic Echocardiography

Majid Maleki[1], MD; Azin Alizadehasl*[2], MD; Mohaddeseh Behjati[3], MD; Moussa Youssef[3], MD

ABSTRACT

The manifestation of cardiac masses varies considerably depending on their location. Among the primary cardiac tumors, sarcomas are the most common. Sarcomas spread mostly to lungs, but metastasis to other sites such as the liver has also been reported. Here, we report a case of a large primary cardiac sarcoma with metastasis to the liver. The patient was a 76-year-old woman who presented with dyspnea. Echocardiography revealed a thickened involved right ventricular free wall and a large multi-lobulated mass featuring multiple cavitations and necrotic foci with attachment to the right atrial free wall and extension to the atrioventricular groove.

The abdominal and pelvic sonographic examination illustrated multiple heterogeneous non–well-defined masses in the liver parenchyma. The biopsy result was a cardiac sarcoma.

The patient refused any therapeutic intervention. ***(Iranian heart Journal 2018; 19(3): 68- 70)***

KEYWORDS: Primary cardiac sarcoma, Metastatic cardiac mass, Transthoracic echocardiography, Cardio-oncology

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Most often, cardiac masses are secondary to heart metastasis. [1] Among the primary cardiac masses, sarcomas are the most common. [2] Cardiac masses can be originated anywhere within the heart, with variable presentations. [3] Most cardiac masses are detected incidentally on echocardiography. [4]

Cardiac masses have captured the imagination of the medical community since the advent of echocardiography. The reason lies in the fact that the overall prevalence of primary cardiac tumors is exceedingly rare, less than 0.1% in large autopsy series. Accordingly, most cardiac tumors are found incidentally during routine cardiac imaging—especially transthoracic echocardiography (TTE). Thus, echocardiography is the imaging modality of choice on the strength of its availability and applicability. Another strong point of echocardiography is its ability not only to delineate multiple cardiac structures and the characteristics of a mass such as its mobility, attachment, and potential hemodynamic consequences but also to confer serial imaging

over time without the need for radiation or iodine or gadolinium contrast agents. [5]

The current brief report on a large primary cardiac sarcoma with metastasis to the liver seeks to underscore the important role of TTE as the first noninvasive choice in the diagnosis of cardiac masses.

CASE PRESENTATION

A 76-year-old woman with dyspnea was referred to our department for TTE. The patient had a remote history of coronary artery bypass graft surgery and had been enrolled many years previously in the Cardiovascular Disease and Risk Factors Study. [6]

The echocardiographic examination revealed a thickened right ventricular (RV) free wall (1.2 cm) and a large multi-lobulated mass featuring multiple cavitations and necrotic foci (size=8.5×6.5 cm) with attachment to the right atrial free wall and extension to the atrioventricular groove. The extension of this tumoral mass to the RV free wall had resulted in moderate RV systolic dysfunction. No significant valvular heart disease was found. Mild pericardial thickening with moderate-to-severe circumferential pericardial effusion (maximum size=about 2.5 cm posterior to the left ventricle) was seen without compressive effects on the RV. There was no diastolic collapse in the RV. The mitral and tricuspid inflows exhibited no significant respiratory variations. The inferior vena cava was dilated, with a reduced respiratory collapse. The pulmonary artery pressure was within the normal limit.

The abdominal and pelvic sonographic examination depicted multiple heterogeneous non–well-defined masses in the liver parenchyma. The pathology specimen from the liver showed a cardiac sarcoma with metastasis to the liver.

She refused any therapeutic intervention.

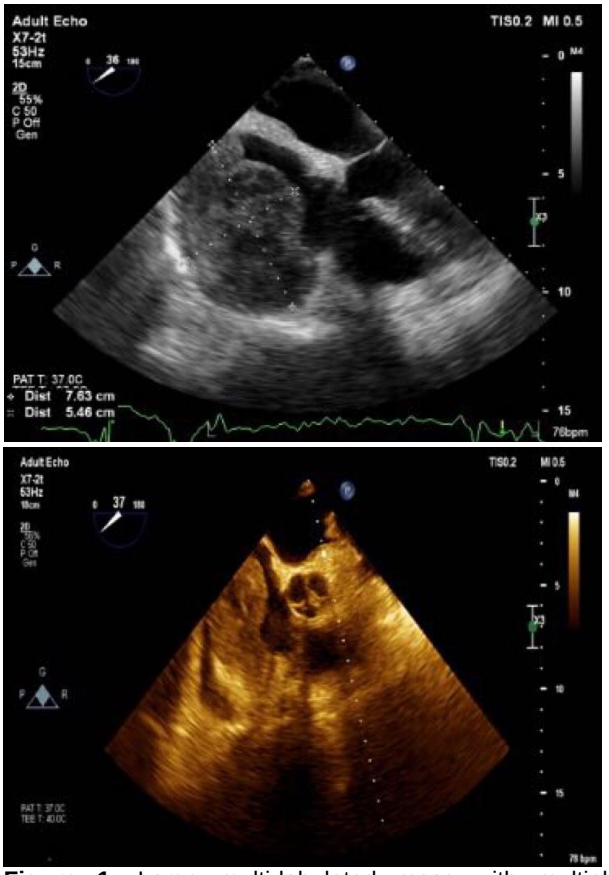

Figure 1. Large multi-lobulated mass with multiple cavitations and necrotic foci (size=8.5×6.5 cm) with attachment to the right atrial free wall and extension to the atrioventricular groove

CONCLUSIONS

TTE can be the first imaging modality in the detection of cardiac masses. A widely accessible and noninvasive method, echocardiography facilitates the establishment of differential diagnoses, the appraisal of hemodynamic consequences, and the formulation of the management plans and follow-ups of cardiac tumors.

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Iranian Heart Journal; 2018; 19 (3)

Case Report

Challenging Case: Right Ventricular Noncompaction or Multiple Diverticula?

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ABSTRACT

Background: Congenital ventricular diverticula, defined as a protrusion of the free wall of the ventricle including the endocardium, the myocardium, and the pericardium, behave similarly to an accessory ventricular chamber which contracts synchronously with the normal ventricles.

Case Presentation: A 42-year-old man presented with functional class II exertional dyspnea, fatigue, and flushing. Transthoracic echocardiography showed deep recesses with the outpouching of the basal-to-mid free wall and septal hyperkinesia. All the echocardiographic data were highly suggestive of isolated right ventricular (RV) noncompaction. Magnetic resonance imaging revealed multiple large outpouchings in the RV free wall, the RV outflow tract, and the basal anterior left ventricular wall, which had a wide neck and a normal contractility. The left ventricular myocardium was hypertrabeculated but did not fulfill the noncompaction criteria of cardiac magnetic resonance imaging.

Conclusions: A muscular type of diverticula with prominent trabeculation and normal contractility, but without abnormalities, on both perfusion and gadolinium enhancement images was reported here. Such cases should not be mistaken for noncompaction or pseudoaneurysms. ***(Iranian heart Journal 2018; 19(3): 71- 73)***

KEYWORDS: Congenital ventricular diverticula, Cardiac magnetic resonance, Transthoracic echocardiography

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Ventricular diverticula constitute a rare anomaly with a localized protrusion of the free wall. [1] Ventricular diverticula may be asymptomatic or be associated with heart failure, valvular regurgitation, ventricular arrhythmias, ventricular rupture, systemic embolization, or sudden death. From a clinical point of view, ventricular diverticula should be

clearly differentiated from aneurysms. [2] Hereby, we present a challenging case which required a definitive diagnosis between right ventricular (RV) noncompaction and multiple diverticula.

Case Presentation

A 42-year-old man presented with symptoms of functional class II exertional dyspnea, fatigue, and flushing of 3 months' duration. His blood pressure and heart rate were 125/82 mm Hg and 76 beats/min, respectively. Twelve-lead electrocardiography showed a complete right bundle branch block. There was no family history of cardiomyopathy, although his first-degree relatives had not been screened. Chest radiography was normal. The results of the routine hematological and biochemical parameters were within the normal range.

Transthoracic echocardiography showed a normal systolic left ventricular (LV) function, a normal RV function (RV strain=up to -36%), a mild RV dilation, an increased RV free wall, apical RV trabeculation, and deep recesses in the mid RV free wall. Visible diastolic outbulging in the basal RV free wall segment was seen in addition to septal hypokinesia. All the echocardiographic data were highly indicative of isolated RV noncompaction. Coronary artery disease was ruled out by coronary angiography, which revealed no atherosclerotic lesions. Further evaluation was done via magnetic resonance imaging (MRI), which showed a normal LV ejection fraction (60%). Also observed were septal hypokinesia and multiple large outpouchings at the RV free wall, the RV outflow tract, and the basal anterior LV wall, which had a wide neck, a normal contractility, and near-complete emptying (Fig. 1). The LV myocardium was hypertrabeculated but did not fulfill the noncompaction criteria of cardiac MRI. The interventricular septum was deviated toward the LV, with a mildly reduced RV systolic function. Delayed enhancement images illustrated no scar formation. In addition, there were thick para-epicardial fat pads filling the space between the RV free wall outpouchings (Fig. 2 and 3). All the cardiac MRI findings were in favor of biventricular diverticula.

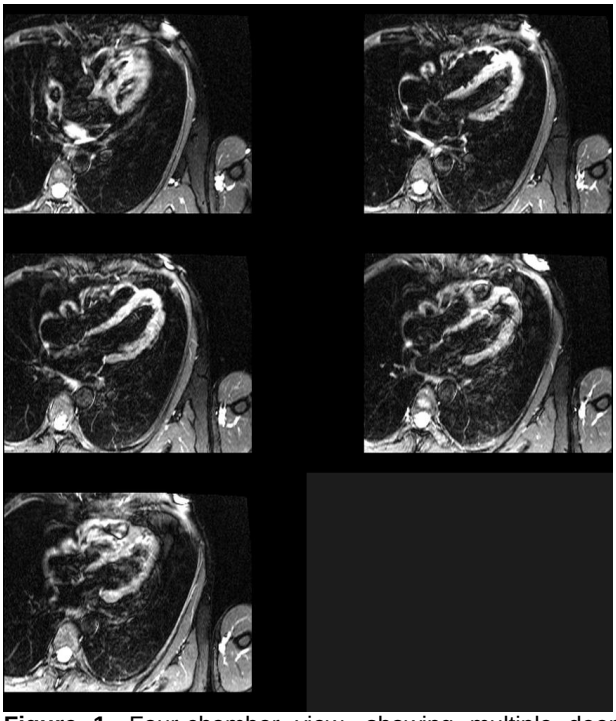

Figure 1. Four-chamber view, showing multiple deep recesses and hypertrabeculation in the right ventricular free wall and a right-sided interventricular septum

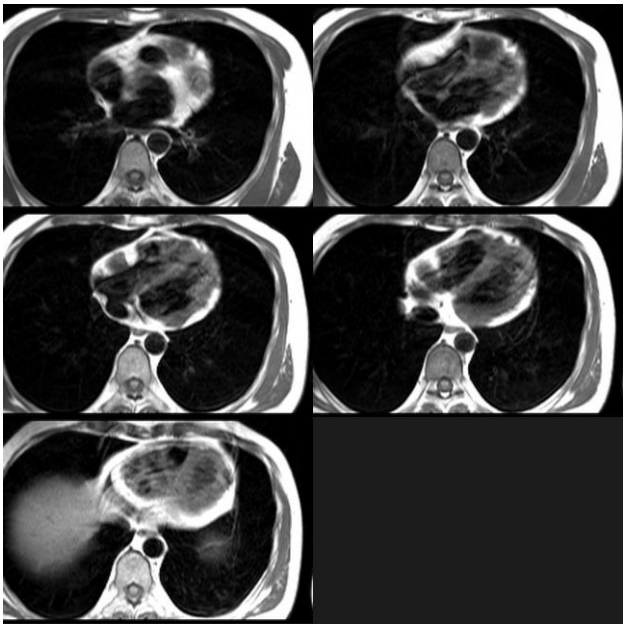

Figure 2. Multislice axial TSE T_1-weighted imaging, showing thick and bright para-epicardial fat pads (arrows), which are projected between the basal-to-mid right ventricular free wall outpouchings

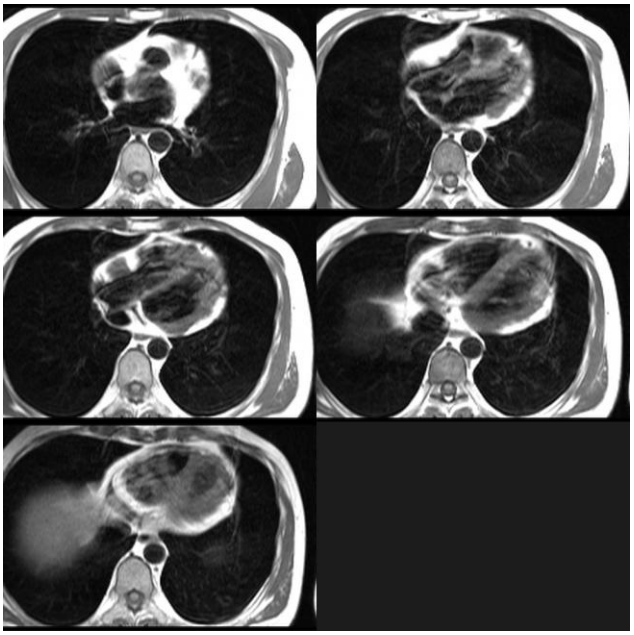

Figure 3. Multislice axial TSE T_1- weighted imaging with a fat suppression sequence, showing suppressed fat tissues (dark signals) between the right ventricular free wall outpouchings

DISCUSSION

Cardiac diverticula constitute a very rare malformation of the heart usually arising from the LV. Nevertheless, there have been many cases presenting with RV, biventricular, or right atrial origins. [3] The etiology of cardiac diverticula is not fully clear. Congenital ventricular diverticula have been classified as fibrous and muscular types. [4] The fibrous type is localized either in the apical or subvalvular area, exhibits a narrow neck, and often leads to mitral and aortic regurgitation. The muscular type is most often localized at the apical part of the inferior or anterior wall of the LV. [5] The muscular type involves all the 3 layers of the heart and usually merges from the apex but rarely from the RV or both chambers.

LV diverticula should be differentiated from LV aneurysms or pseudoaneurysms in patients with a history of cardiac surgery or in adults at risk for atherosclerotic heart disease. LV aneurysms and pseudoaneurysms usually occur as a late consequence of myocardial infarction, rupture, or trauma. LV aneurysms and pseudoaneurysms are akinetic or dyskinetic structures, whereas most diverticula (the muscular type) contract during ventricular systole. MRI has the potential not only to identify but also to categorize diverticula noninvasively and differentiate between muscular contracting and noncontracting fibrous ones. MRI allows a complete assessment of congenital LV diverticula by identifying fibrous from muscular types and determining the relationship with the other cardiac structures. Because of its noninvasive nature and parameter reproducibility, MRI alone can provide an excellent monitoring of LV diverticula follow-up in patients treated with the conservative approach.

CONCLUSIONS

A muscular type of diverticula with prominent trabeculation and normal contractility, but without abnormalities, on both perfusion and gadolinium enhancement images was reported here. Such cases should not be mistaken for noncompaction or pseudoaneurysms.

Conflict of Interest: There was no conflict of interest.

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Case Report

Rare Form of Coronary Artery Anomalies in Adults

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ABSTRACT

The congenital atresia of the left main coronary artery is a very rare form of coronary anomalies with poor clinical outcomes if left untreated. Patients require surgical correction with coronary artery bypass grafting after the diagnosis. Here, we report a case of the congenital left main atresia in a 36-year-old woman who had a previous heart surgery with this anomaly having gone undetected. ***(Iranian heart Journal 2018; 19(3): 74- 76)***

KEYWORDS: Congenital heart disease, Left main atresia, Coronary abnormality

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The left main coronary artery atresia (LMCAA) is a rare form of coronary anomalies in which the left coronary ostium is absent and has a blind aortic end. The blood flow to the left heart chambers is provided by collaterals from the right coronary artery. The prognosis is poor due to the occurrence of myocardial ischemia and ensuing myocardial dysfunction and arrhythmias. [1,2] The management in adults consists of surgical revascularization with arterial and venous bypass grafts placed on the left anterior descending (LAD) and left circumflex (LC_X) arteries. In the present case, we report a patient with the congenital LMCAA accompanied by subvalvular aortic stenosis not detected at the time of her first operation. [3-5]

CASE REPORT

A 36-year-old woman referred to the adult congenital heart disease clinic for follow-up. The patient complained of atypical chest pain episodes. She had a history of the surgical repair of subvalvular aortic stenosis at childhood, and there was no record of coronary anomalies detected during the previous surgery. On physical examination, there was a grade III/VI systolic murmur at the left sternal border. Echocardiographic evaluations revealed the recurrence of severe subvalvular stenosis and severe aortic regurgitation. The patient underwent cardiac catheterization, during which an ectatic and tortuous right coronary artery filling the left system retrogradely was visualized. Attempts to engage the left main coronary artery failed (Fig. 1). Coronary computed tomography angiography (CTA) with a 3D reconstruction was performed, and it showed that the left main ostium was atretic, confirming the diagnosis of the congenital LMCAA (Fig. 2).

The patient was scheduled for cardiac surgery, during which she received a saphenous vein graft on the LC_X and an internal mammary artery graft on the LAD. The subvalvular stenosis was also repaired, and the aortic valve was replaced. She had an uneventful recovery.

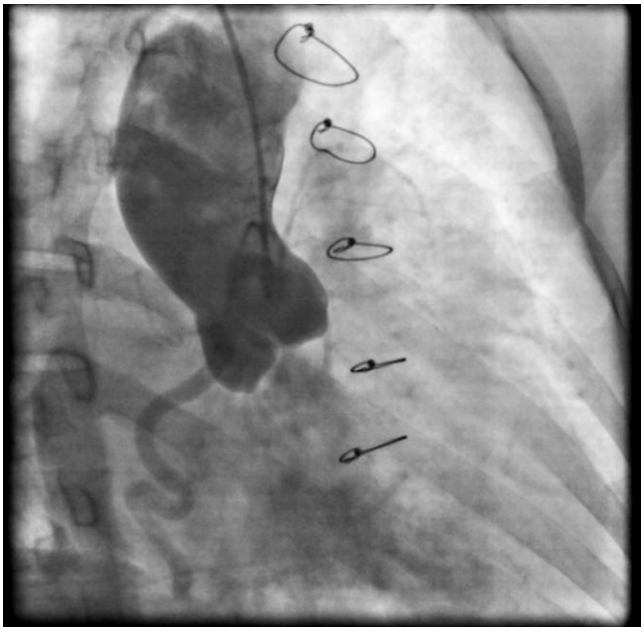

Figure 1. No filling of the left system during the aortic root injection

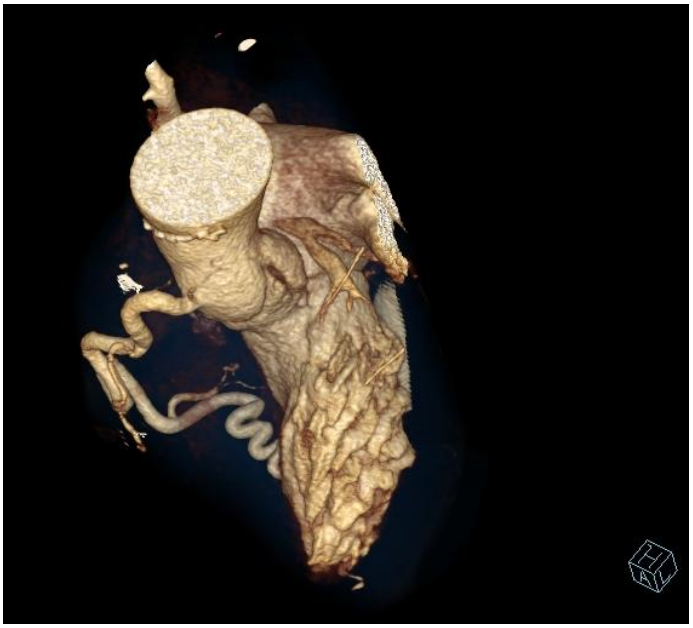

Figure 2. Tortuous right coronary artery and a blind left main coronary artery ostium

DISCUSSION

The clinical diagnosis of the LMCAA might be neglected due to the wide range of nonspecific presenting symptoms—including chest pain in a young patient, dyspnea, and syncope—and aborted sudden cardiac death. [2,6-8] Patients could remain asymptomatic for a long time due to a well-developed collateral system. The LMCAA is often an isolated anomaly; however, associations with other congenital heart defects such as pulmonary stenoses, bicuspid aortic valves, supravalvular aortic stenoses, and ventricular septal defects have been described. [2,6] Selective coronary angiography is helpful, but multislice CTA can provide more precise details in a less invasive manner and is, therefore, recommended for the evaluation of congenital coronary abnormalities.[9]

Patients with the LMCAA should undergo surgical correction with the restoration of the antegrade flow to the left coronary system. Nevertheless, there are no guidelines on the management due to the scarcity of the condition. [10]

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Instructions to Authors

Iranian Heart Journal is the official quarterly publication of the Iranian Heart Association and publishes original papers, review articles, case reports, and brief communications on topics in pediatric and adult cardiology, cardiac surgery, cardiac anesthesia, and related issues from all over the world.

The aim of *Iranian Heart Journal* is to advance scientific knowledge and understanding concerning all aspects of cardiovascular disease, and its scope covers medical students, residents in training, and fellows as well as specialists in cardiology, cardiac surgery, cardiac anesthesia, and vascular surgery.

In order to submit a paper, you are kindly requested to read and observe the following guidelines carefully.

Authors are notified when a manuscript is received. Each article is considered individually and undergoes a careful review process by the Editorial Board. Additional review may be requested from specialists in the related field. The final decision regarding acceptance or rejection of an article will be forwarded to the first author as soon as possible. Accepted articles for publication will undergo corrective formatting and editing by the Technical Editor (s) who reserves the right to make any changes or deletions necessary in order to make the paper suitable for publication and update it to *Iranian Heart Journal's* format. Received manuscripts will not be returned unless specifically requested by the author and accompanied by a self-addressed, stamped envelope.

Guidelines

The manuscript should be an original work (clinical or basic research) or interesting case presentation. Submitted papers must not be published or under consideration for publication elsewhere. Previous presentation of the work in medical congresses or symposiums are acceptable but must be mentioned in the footnotes.

Review articles are considered only from authoritative experts with previous published work in their respective fields, and must include their previous publications in the references. Material must be presented in short, interesting, and well-phrased sentences and paragraphs. Reviews should be informative, presenting the most recent advances and information on the subject. They should not be an exhaustive review of what could be easily found in textbooks.

Generic names instead of trade names must be used for medications (eg, propranolol instead of Inderal®) and standard abbreviations may be used after presenting the unabbreviated form in the text. Manuscripts not meeting these criteria will be returned to the authors for correction before undergoing evaluation by the Editorial Board for publishing.

- Type manuscripts double spaced throughout, including title page, abstract, text, references, tables, and legends. Standard text font is Times New Roman 12.
- Arrange manuscripts as follows: (1) title page, (2) abstract, (3) text, including introduction, material or patients and methods, results, discussion, and conclusion, (4) references, (5) tables, and (6) legends. Number the pages consecutively, beginning with the title page as 1 and ending with the legend page. Page numbers should be at the bottom center of each page.
- Average length for original articles is 5 printed pages, equivalent to 20 double-spaced manuscript pages: 1 title page, 1 abstract page, 10 pages of text, 4 tables or illustrations, 1 page of figure legends, and not more than 20 references. Text for case reports should be no more than

4 double-spaced typewritten pages, and correspondences no more than 2 double-spaced manuscript pages.

- The title page should include the title, authors and their academic degrees, name and location of the institutional affiliation or department (no more than 2), and address, telephone number, fax number and Email address for reprint requests at the bottom of the page. If more than 1 institution is named, indicate which authors are affiliated with each.
- **Titles** should be as short as possible (fewer than 95 letters and spaces). Also submit a short title of 40 characters to be used as a running title.
- **Abstracts** should be no longer than 250 words and should contain 4 sections in the following order: Background, Methods, Results, and Conclusions. Abstracts for case reports and correspondences should not be structured and must be shorter (50 to 75 words). Include keywords at the end of the abstract.
- **Text** should be organized as follows: Introduction, Methods, Results, Discussion, and Conclusion. Methods should include the statistical analysis. Cite references, illustrations, and tables in numeric order in the text. Give all measurements and weights in standard metric units. Credit suppliers of drugs, equipment, and other brand-name material mentioned in the article in parentheses, giving company name and location.
- **Acknowledgements** All contributors who do not meet the criteria for authorship may be mentioned in the acknowledgements section. It should include persons who provided technical help, writing assistance, and departmental supervision who only provided general support. Financial and material support should also be acknowledged.
- **Conflict of interest** Authors must acknowledge and declare any sources of funding and potential conflicting interest, such as receiving funds or fees by, or holding stocks and shares in, an organization that may profit or lose through the publication of the paper. Declaring a competing interest will not lead to the automatic rejection of the paper.
- **Ethical guidelines** must be addressed in the Materials and Methods section. (1) Please state that informed consent was obtained from all human adult participants and from the parents or legal guardians of minors. Include the name of the appropriate institutional review board that approved the project. (2) Indicate in the text that the maintenance and care of experimental animals complies with National Institutes of Health guidelines for the humane use of laboratory animals, or those of your institute or agency.
- **References** should be identified by using superscript numbers without changing the font size (eg,[1, 2, 3]). Do not cite personal communications, manuscripts in preparation, or unpublished data. Type the references double spaced on a separate sheet and number consecutively in the order in which they are mentioned in the text. List all authors if 6 or fewer; otherwise list the first 6 and add *et al*. Style and punctuation of references should conform to the Vancouver style or the *Index Medicus* format as in the examples below:

Journal articles:

1. Burt VL, Cutler JA, Higgins M, Horan MJ, Labarthe D, Whelton P, et al. Trends in the prevalence, awareness, treatment and control of

hypertension in the adult US population. Hypertension 1995; 26: 60-69.

Chapters in books:

2. Ross DN, Martelli V, Wain WH: Allograft and autograft valves used for aortic valve replacement. In: Ionescu MI, (ed.). Tissue Heart Valves. London: Butterworth, 1979: pp. 319-29.

- **Tables** should be typed double spaced on separate sheets, each with a table number and title above the table and explanatory notes and legends below. Tables should be self-explanatory and the data should not be duplicated in the text or figures. If tables provide repetitive information, they will be deleted.
- **Legends** to illustrations should be typed double spaced on a separate sheet. Numbers should correspond to the order in which they appear in the text. Give the type of stain and magnification power for photomicrographs. Patients should not be recognizable in illustrations unless written consent is supplied.
- **Illustrations** should be submitted digitally (preferable), or in 3 sets of glossy prints. High-quality laser artwork is also acceptable, but photocopies are not. Write the first author's last name, figure number, and an arrow indicating the top of the figure on the back of each illustration in pencil. All illustrations will be published in black and white unless color prints are specifically requested by the author(s). The author must be prepared to pay a fee for publication of color photographs.
- **Reprints:** Reprints can be ordered at an extra charge. Contact the Editorial Office for details.

Electronic manuscripts

All authors are ***strongly encouraged*** to submit their manuscripts via Email using Microsoft Office Word (2003 or afterward) in order to allow more rapid editing and preparation for publication. The author should retain copies of all files as backup. Emails should bear the author's name, short title of the article, and operating system used.

All manuscripts and correspondences should be submitted to:

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Tehran 19974 Iran
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Forthcoming Meetings

Clinically Focused Robotics Series: Thoracic Surgery
Thursday, October 4, 2018 to Friday, October 5, 2018
Florida Hospital Nicholson Center
Celebration, FL
United States
See map: Google Maps

15th Annual Multidisciplinary Cardiovascular and Thoracic Critical Care Conference
Thursday, October 4, 2018 to Saturday, October 6, 2018
Omni Shoreham Hotel
Washington, DC
United States
See map: Google Maps

Cardiovascular Disease Management: A Case-Based Approach, 6th Annual Symposium
Thursday, October 11, 2018 to Friday, October 12, 2018
Arizona Biltmore
Phoenix, AZ
United States
See map: Google Maps

Heart Failure in the Heartland
Friday, October 12, 2018
Graduate Iowa City Hotel (Formerly the Sheraton)
Graduate Hotel 210 S. Dubuque Street
Iowa City, IA
United States
See map: Google Maps

McGill University's Annual Symposium on Upper Gastro-Intestinal Cancers
Saturday, October 13, 2018
Research Institute of the McGill University Health Centre, Glen Site
1001 Decarie Blvd
Montreal, QC
Canada
See map: Google Maps

Advanced Congenital Cardiac Morphology Course
Sunday, October 14, 2018 to Thursday, October 18, 2018
Ruth and Tristram Colket, Jr. Translational Research Building at ovChildren's Hospital of Philadelphia
Philadelphia, PA
United States
See map: Google Maps

56th Annual Meeting of the Eastern Cardiothoracic Surgical Society
Wednesday, October 17, 2018 to Saturday, October 20, 2018
Opal Sands Resort
430 South Gulfview Boulevard
Clearwater Beach, FL
United States
See map: Google Maps

The George Washington University Hospital's Second Annual Adult Extracoporeal Life Support Symposium
Saturday, October 20, 2018
The Hyatt Regency Tysons Corner
Tysons, VA
United States
See map: Google Maps

29th Annual Cardiovascular Interventions 2018
Tuesday, October 23, 2018 to Friday, October 26, 2018
Hilton La Jolla Torrey Pines
La Jolla, CA
United States
See map: Google Maps

AATS Clinical Trials Methods Course
Thursday, October 25, 2018 to Saturday, October 27, 2018
Hyatt Regency O'Hare
Chicago, IL
United States
See map: Google Maps

2nd International Conference on Cardiology & Cardiac Nursing
Thursday, October 25, 2018 to Saturday, October 27, 2018
Paris
France
See map: Google Maps

Turkish Society of Cardiovascular Surgery 15th Congress
Friday, October 26, 2018 to Monday, October 29, 2018
Titanic Hotel Congress Center
Belek / Antalya
Turkey
See map: Google Maps

Advanced Minimally Invasive Thoracic Procedures
Saturday, October 27, 2018 to Sunday, October 28, 2018
The Ritz-Carlton Laguna Niguel
Dana Point, CA
United States
See map: Google Maps

13th European Mechanical Circulatory Support Summit (EUMS)
Thursday, November 1, 2018 to Saturday, November 3, 2018
Berlin
Berlin
Germany
See map: Google Maps

Philadelphia Cardiovascular Summit
Friday, November 2, 2018 to Saturday, November 3, 2018
Sofitel Philadelphia
Philadelphia , PA
United States
See map: Google Maps

Philadelphia Cardiovascular Summit
Friday, November 2, 2018 to Saturday, November 3, 2018
Sofitel Philadelphia
Philadelphia, PA
United States
See map: Google Maps

AATS Focus on Thoracic Surgery: Lung and Esophageal Cancer
Saturday, November 3, 2018 to Sunday, November 4, 2018
Grand Hyatt Guangzhou
Guangzhou
China
See map: Google Maps

9th Mulu Rafflesia Heart Valve Symposium
Wednesday, November 7, 2018 to Saturday, November 10, 2018
Shozan Kitayama Rikyuu Conference Centre
Kyoto
Japan
See map: Google Maps

Simplified Extracorporeal Life Support Training Course
Saturday, November 10, 2018 to Sunday, November 11, 2018
TandemLife/LivaNova
620 Alpha Drive
Pittsburgh, PA
United States
See map: Google Maps

Simplified Extracorporeal Life Support Training Course
Saturday, November 10, 2018 to Sunday, November 11, 2018
TandemLife/LivaNova
620 Alpha Drive
Pittsburgh, PA
United States
See map: Google Maps

Congenital Heart Disease
Tuesday, November 13, 2018 to Friday, November 16, 2018
EACTS House
Windsor
United Kingdom
See map: Google Maps

STS/EACTS Latin America Cardiovascular Surgery Conference
Thursday, November 15, 2018 to Saturday, November 17, 2018
Hilton Cartagena
Cartagena
Colombia
See map: Google Maps

STS/EACTS Latin America Cardiovascular Surgery Conference
Thursday, November 15, 2018 to Saturday, November 17, 2018
Hilton Cartagena
Cartagena
Colombia
See map: Google Maps

Controversies & Advances in the Treatment of Cardiovascular Disease
Thursday, November 15, 2018 to Friday, November 16, 2018
Montage Beverly Hills
Beverly Hills, CA
United States
See map: Google Maps

4th AMRITA Heart Conclave 2018: A Workshop on Aortic Root Surgery
Saturday, November 17, 2018 to Sunday, November 18, 2018
Amrita Institute of Medical Sciences and Research Centre
Kochi, KL
India
See map: Google Maps

4th Amrita Heart Conclave 2018: A Workshop on Aortic Root Surgery
Saturday, November 17, 2018 to Sunday, November 18, 2018
Amrita Institute of Medical Sciences and Research Centre
Kochi, KL
India

See map: Google Maps

8th International Aortic Summit
Thursday, November 22, 2018 to Sunday, November 25, 2018
Hotel Ramadha Plaza
Chennai , TN
India
See map: Google Maps

Professional Leadership
Monday, November 26, 2018 to Tuesday, November 27, 2018
EACTS House
Windsor
United Kingdom
See map: Google Maps

Fourth International Joint Meeting on Thoracic Surgery
Wednesday, November 28, 2018 to Friday, November 30, 2018
Foment del Treball Nacional
Barcelona
Spain
See map: Google Maps

Mastering the Mitral Valve: A Case Based Approach
Friday, November 30, 2018 to Saturday, December 1, 2018
JW Marriott Essex House
New York City, NY
United States
See map: Google Maps

BISMICS 2018 Annual Meeting
Thursday, December 6, 2018 to Friday, December 7, 2018
Spencer Dock Convention Centre North Wall Quay
Dublin
Ireland
See map: Google Maps

Endoscopic Port-Access Mitral Valve Repair Drylab Training
Thursday, December 13, 2018 to Friday, December 14, 2018
Maastricht University Medical Center (MUMC)
Maastricht
Germany
See map: Google Maps

Endoscopic Port-Access Mitral Valve Repair Drylab Training
Thursday, December 13, 2018 to Friday, December 14, 2018
Maastricht University Medical Center (MUMC)
Maastricht
Netherlands
See map: Google Maps

4th International Conference on Anesthesia and Pain Medicine
Thursday, December 13, 2018 to Saturday, December 15, 2018
Radisson Blu, Yas Island
Abu Dhabi
United Arab Emirates
See map: Google Maps

Simplified Extracorporeal Life Support Training Course
Saturday, January 12, 2019 to Sunday, January 13, 2019
TandemLife/LivaNova
620 Alpha Drive
Pittsburgh, PA
United States
See map: Google Maps

Simplified Extracorporeal Life Support Training Course
Saturday, January 12, 2019 to Sunday, January 13, 2019
TandemLife/LivaNova
620 Alpha Drive
Pittsburgh, PA
United States
See map: Google Maps

30th European Heart Diseases and Heart Failure Congress
Monday, February 18, 2019 to Tuesday, February 19, 2019
Hyatt Place Airport Hotel
Rijnlanderweg 800 Hoofddorp
Amsterdam
Netherlands
See map: Google Maps

27th ASCVTS & 65th IACTSCON
Thursday, February 21, 2019 to Sunday, February 24, 2019
ITC Grand Chola
Chennai, TN
India
See map: Google Maps

22nd International Conference on New Horizons in Cardiology & Cardiologists Education
Thursday, March 7, 2019 to Friday, March 8, 2019
Berlin, Germany
Berlin
Germany
See map: Google Maps

SCTS Annual Meeting & SCTS Ionescu University
Sunday, March 10, 2019 to Tuesday, March 12, 2019
Queen Elizabeth Conference Centre
London
United Kingdom
See map: Google Maps

SCTS Annual Meeting & SCTS Ionescu University
Sunday, March 10, 2019 to Tuesday, March 12, 2019
Queen Elizabeth Conference Center
London
United Kingdom
See map: Google Maps

Middle East Heart Congress
Monday, March 18, 2019 to Wednesday, March 20, 2019
Dubai UAE
Dubai
United Arab Emirates
See map: Google Maps

New Zealand National Cardiac Surgery Meeting - Tongariro Meeting
Friday, March 22, 2019 to Sunday, March 24, 2019
Napier Conference Centre
Napier, HKB
New Zealand
See map: Google Maps

4th Edition of World Congress & Exhibition on Vascular Surgery
Thursday, March 28, 2019 to Friday, March 29, 2019
Rome
Rome
Italy
See map: Google Maps

5th World Heart Congress 2019
Monday, April 15, 2019 to Tuesday, April 16, 2019
Amsterdam, Netherlands
Amsterdam
Netherlands
See map: Google Maps

AATS 99th Annual Meeting
Saturday, May 4, 2019 to Tuesday, May 7, 2019
Metro Toronto Convention Centre
Toronto
Canada
See map: Google Maps

2nd International Pharmaceutical Conference and Expo
Wednesday, June 5, 2019 to Friday, June 7, 2019
Doubletree by Hilton BWI Airport
Baltimore, MD
United States
See map: Google Maps

29th International Conference on Cardiology and Healthcare
Monday, June 10, 2019 to Tuesday, June 11, 2019
Helsinki, Finland
Helsinki
Finland
See map: Google Maps

7th International Conference on Hypertension & Healthcare
Monday, June 10, 2019 to Tuesday, June 11, 2019
Helsinki, Finland
Helsinki
Finland
See map: Google Maps

31st Annual Cardiologists Conference
Monday, June 17, 2019 to Wednesday, June 19, 2019
Holiday Inn Rome Aurelia
Rome
Italy
See map: Google Maps

31st Annual Cardiologists Conference
Monday, June 17, 2019 to Wednesday, June 19, 2019
Holiday Inn Rome Aurelia
Rome
Italy
See map: Google Maps

6th MAORI Symposium: Complex Diseases of Thoracic and Thoraco-Abdominal Aorta
Tuesday, June 18, 2019 to Wednesday, June 19, 2019
University Campus "Salvatore Venuta" Building H,
Auditorium Room B, Level 2
Catanzaro
Italy
See map: Google Maps

13th International Conference on Surgery and Anesthesia
Wednesday, June 19, 2019 to Thursday, June 20, 2019
Novotel Brisbane
Brisbane
Australia
See map: Google Maps

ASAIO 65th Annual Conference
Wednesday, June 26, 2019 to Saturday, June 29, 2019
The San Francisco Hilton
San Francisco
United States
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