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Ageless window in minimally invasive cardiac surgery: Periareolar incision

Ayhan Muduroglu

Department of Cardiovascular Surgery, Bursa City Hospital, Bursa, Türkiye

ABSTRACT

Aim: To present the experiences and outcomes in patients who underwent minimally invasive cardiac surgery via periareolar incision.

Methods: A total of 17 patients who underwent minimally invasive cardiac surgery via periareolar incision were included in the study. Patients' demographic data such as age and gender, diagnosis, type of procedure, postoperative complications and outcomes were recorded and retrospectively reviewed.

Results: In the study population, 11 patients (64.7%) were female and 6 patients (35.3%) were male. The mean age of the patients was 57.6±16.3 years. In a patient with very large breast, the surgical incision was converted from periareolar to submammary incision due to poor exposure. Mortality occurred in one patients due to vasoplegic syndrome.

Conclusion: The present analysis revealed that periareolar incision was a safe, effective and cosmetically satisfactory method for patients undergoing minimally invasive cardiac surgery.

Key words: Periareolar incision, minimally invasive surgery, cardiac surgery.

✉ *Dr. Ayhan Muduroglu*

Department of Cardiovascular Surgery, Bursa City Hospital, Bursa, Türkiye

E-mail: ayhanmuduroglu1@gmail.com

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Introduction

Minimally invasive cardiac surgery, which is considered to overcome the well-known problems of median sternotomy, is a standard method that has proven its reliability and effectiveness over the 27 years since it started in 1996 [1]. Axiliary, infraaxiliary, right and left anterior minithoracotomy, superior and inferior partial sternotomy, and subxyphoid incisions have been defined for access to the mediastinum. Although these approaches do lowers the problems associated with sternotomy they do not abolish all of them, hence there are still searches for other approaches such as periareolar incision in the field of minimal invasive cardiac surgery. Minimal invasive surgery entails the wound to be small, lack of or minimal use of extracorporeal circulation, the patient being conscious and awake with no anesthesia or being under minimal anesthesia.

However, in clinical practice, minimally invasive approach is usually evaluated on the basis of the size of the wound. Even though minimal invasive surgery is regarded as on par with conventional surgery and a standard it comes with a difficult learning curve [2]. For example, this figure is on average 100 cases (approximately 75-125 cases) for mitral valve surgery [3]. It is recommended to experience this curve in a center with as high volume as possible [2,3].

In order to minimize and hide the skin scar, periareolar incision (PAI) that had been

performed by the plastic surgeons since 1970, was firstly performed in cardiac surgery in 2006 and was published in 2009 [4]. However, the problems that may occur in breast tissue with this incision were feared and did not gain popularity. Considering the experience in plastic surgery, and increase in the modest experience of the cardiac surgeons and the demand by patients with their rising aesthetic concerns, we suggest that PAI is a safe and a good alternative.

The aim of this study was to present the experiences and outcomes in patients who underwent minimally invasive cardiac surgery via periareolar incision.

Materials and methods

This study included a total of 17 consecutive patients who underwent minimally invasive cardiac surgery via periareolar incision between January 2018 and December 2022. Patients' demographic data such as age and gender, diagnosis, type of procedure, postoperative complications and outcomes were recorded, analyzed and then retrospectively reviewed. It can be used in many cardiac pathologies such as mitral, tricuspid valve, coronary artery diseases, atrial septal defect, mixoma, pericardial biopsy, which can be performed with mini thoracotomy. Patients with body mass index > 40 kg/m² and those with a history of previous cardiac surgery were excluded from the study.

Surgical approach

All patients were operated under general anaesthesia by a single experienced cardiovascular surgeon (A.M.). External defibrillator pad was placed on the right scapula and on lateral thorax along the 5th intercostal space. Double lumen intubation was employed. Transesophageal echocardiogram (TEE) probe was placed. Right thorax was elevated around 20-30 degrees and the arm was in adduction (Figure 1). 1.5 unit/ kg heparin was given after radial artery and jugular venous catheterizations. Superior vena cava cannulation was performed percutaneously through right jugular vein. Through a right femoral incision both common femoral artery and vein were prepared. An inferior periareolar incision was made between clock 3 and 9 on the right periareolar region (Figure 2A, 2F and Figure 3). Access to the mediastinal cavity was established by a thoracotomy through the 4th intercostal space (Figure 3).

Figure 1. Position and landmarks

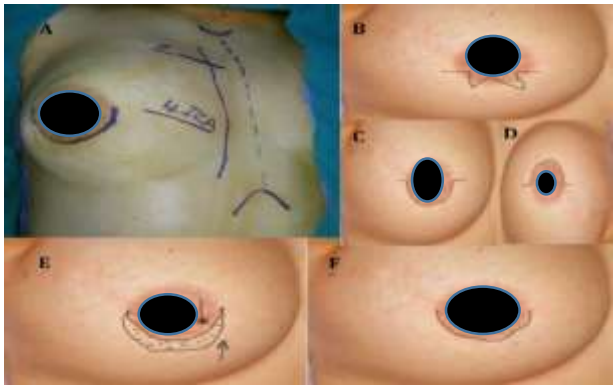

Figure 2. Different periareolar incisions.

Figure 3. Inferior periareolar incision.

Soft tissue retractor was placed to avoid fat embolism. An extra heparin of 1.5 unit/ kg was administered to ensure the ACT was over 450 seconds. Under the guidance of TEE, femoral

arterial and venous cannulations were performed. At the lateral aspect of the termination of the thoracotomy incision the camera port was placed through the 4th intercostal space. With the aid of the camera 5 to 10 mm incisions were made to necessary places, for the chitwood clamp on the anterior axiliary line either at the 2nd or 3rd intercostal space, for left atrial retractor 3rd or 4th intercostal space along the lateral of the right internal mammarian artery, for carbon dioxide and aspirators anterior or mid axiliary line through 6th intercostal space (Figure 1). 2/0 sutures with pledgets were placed on the diaphragm and were brought out of the thorax through the hole created for the aspirator and with traction employed caudal direction the diaphragm was retracted to ensure the encircling of the inferior vena cava. The pericard was incised vertically at least 2 cm away from the phrenic nerve, tension sutures were brought out to apply traction. Extracorporeal circulation was maintained. Patient was cooled approximately to 33 or 34°C. A long antregade cardioplegy cannula was placed in the ascending aorta with the other end brought out through the thoracotomy. Among other procedures are bringing the long cardioplegy cannula through the opening created for the chitwood cannula or the short cannula with long needle can be left in the thoracic cavity, or for long duration cardioplegics the aorta can be punctured once and a vent could be placed at the same puncture site during weaning off. Under the camera chitwood clamp was passed through the transverse sinus and aorta was clamped. To ensure an effective cardioplegy regurgitation from the aorta to the left ventricle was observed with TEE. According to the experience and preference of the surgical team, either long acting cardioplegic solutions such as Custadiol or Del Nido, or short acting solutions such as crystalloid or blood cardioplegic solutions were used. Both superior and inferior vena cavas were snared. The snare of inferior vena cava was brought outside through the 6th intercostal space while superior vena cava was through the thoracotomy. Following diastolic cardiac arrest, cardiac surgical procedures such as repair or replacement of the mitral and tricuspid valves, ASD closure, tumor resection, arrhythmia surgery like RF or cryoablation, closure of the left atrial appendage were performed (Figure 4).

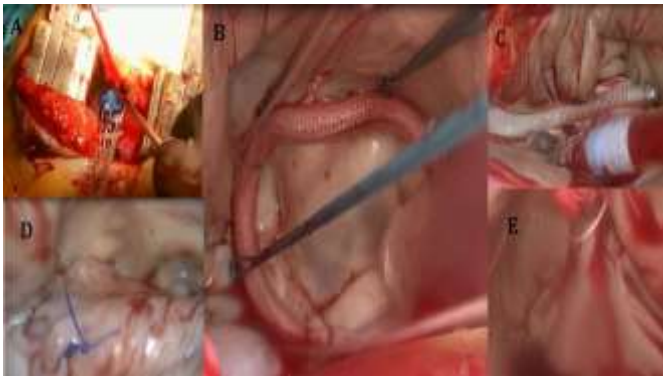

Figure 4. **A**: Mitral valve replacement, **B:** Mitral repair, **C:** Cryoablation, D: Left atrial appendage closure, **E:** Tricuspid Kay anuloplasty.

After weaning from extracorporeal circulation and checking for bleeding, mediastinal and thoracic drains were placed. The thoracotomy was closed with 1 no, breast tissue with 3/0, subcutaneous layer with 3/0, and skin tissue intradermically with 3/0 or 4/0 polyglactin suture materials.

Statistical analysis

Data obtained in the study were entered into a dedicated Microsoft Excel file. Continuous variables were expressed as mean±standard deviation, minimum and maximum values, and categorical variables as number (n) and percentage (%). Statistical analysis was performed using the SPSS version 20 (SPSS, Chicago, IL, USA).

Table 1. Patient characteristics.

Patient	Age	Gender	Diagnosis	Procedure	Complication	Mortality
1	35	F	R-MS	R-PAI; MVR	-	-
2	43	F	(R-MS)+(R-MR)	R-PAI; MVR	-	-
3	64	F	AF+F-MR+ F-TR	R-PAI; (MR-RA) + (TR-KayA) + BACryo + LAAC	-	-
4	71	F	RIP	R-PAİ; PBx+PPW	-	-
5	66	F	DVT+PE+ R-MR+ F-TR +PFO+PAF	R-PAI; MVR+TRA+PFOC +LAAC+LACryo	Vasoplegic syndrome	Exitus
6	75	M	Post PCI-CT	L-PAI; PPW	-	-
7	52	F	(R-MS)+ (R-MR)	From R-PAI to submammary incision converted ; MVR	Poor exposure due to very large breast	-
8	43	F	R-MS	R-PAI; MVR	-	-
9	86	F	RIPE	R-PAI; PBx+PPW	-	-
10	67	F	IPE	L-PAI; PBx+PPW + CA	-	-
11	76	M	RIPE	L-PAI; PBx+PPW	-	-
12	63	M	BP (Staph.)	L-PAI; PBx+PPW+ CA	-	-
13	64	M	SCLC	L-PAI; PBx+PPW	-	-
14	56	F	(R-MS)+ (R-MR)	R-PAI; MVR	-	-
15	48	M	CAD (RCA-Stent)	L-PAI (Reverse Omega insicion -Ω); MİDCAB (LİMA-LAD)	-	-
16	47	F	LA Mixoma + Sarcoidosis	R-PAI; Myxoma excision+Primary interatrial septum closure+mediastinal lymph node and lung biopsy	-	-
17	23	M	SV-ASD+PAPVR	L-PAI (Reverse Omega insicion -Ω); ASD closing and PAPVR repair with fresh pericard	-	-

R-MS; Rheumatic mitral stenosis, R-MR; Rheumatic mitral regurgitation, F-MR: Functional mitral regurgitation, F-TR; Functional tricuspid regurgitation, AF; Atrial Fibtillation, PAF; Paroxysmal atrial fibrillation, DVT; Deep vein thrombosis, PA; Pulmonary embolism, PFO; Patent foramen ovale, PCI-CT; Percutaneous coronary intervention-Cardiac Tamponade, IPE; idiopathic pericardial effusion, RIP; Recurrent idiopathic pericardial effusion, Bacterial pericadrial effusion, SCLC; Small cell lung cancer, CAD; Coronary artery disease, RCA; Right coronary artery, R-PAI; Right periareolar incision, L-PAI; Left periareolar incision, TRA; tricuspid ring annuloplasty, MRA; mitral ring annuloplasty, T-KayA; tricuspid Kay annuloplasty, MVR; Mitral valve replacement, PFOC; Patent foramen ovale colosure, LAAC; Left atrial appendage closure, LACryo; Left atrial cryoablation, BACryo; Biatrial Cryoablation, PBx-PPW; Pericardial biopsy-Pleuropericardial Window, CA; Culture Antibiogram. Staph.; Staphilococcus, LA; Left Atrium, MİDCAB; Minimally Invasive Coronary Artery Bypass, SV-ASD; Sinus venosus atrial septal defect, PAPVR; Partial anomalous pulmonary venous return.

Results

In the study population, 10 patients (66.6%) were female and 5 patients (33.3%) were male. The mean age of the patients was 60.6±14.2 years (range: 35-86). In one patient, because the breast tissue was very large, the length of the retractor feet was not sufficient and thus the surgical incision was converted from periareolar to submammary incision due to poor exposure. One patient developed mortality followed postoperative progressive hypotension due to vasoplegia syndrome despite optimum fluid replacement, high inotrope and vasopressor therapy. Other patients were discharged uneventfully. No cardiac or incisional complications developed in the control visits. None of patients suffered breast-related complaints such as scar, cyst or numbness (Figure 5). All patients were satisfied aesthetically. Patient characteristics are presented in Table 1.

Figure 5. Postoperative control.

Discussion

Since its inception cardiac surgery has been performed with sternotomy which is usually accompanied with pain, not really aesthetic and prone to life threatening infections. The incidence of deep sternal wound infection is 0.5-6% and related hospital mortality is 7-35 % [1]. There is also a possibility of sternal instability without an accompanying infection [2]. Even without these major complications the patient can not lie on his side or drive a car. The healing process of a sternotomy can last up to 3 months [3]. To overcome these problems Cosgrov and Cohn commenced minimal mitral valve surgery by employing parasternal and hemisternotomy in 1996. Nevertheless the sacrificing of the right mammarian artery, the incision of cartilaginous ribs leading to instability of the thoracic wall, pain and the risk of infection due to the partial sternotomy were still lingering. Same year Carpentier described the video assisted right anterior mini-thoracotomy [2]. Carpentier and Mohr performed the first total robotic mitral valve repair in 1998 [2]. With these first approaches many minimal invasive incisions were postulated; J, inverted J, T, inverted T, V shaped inferior and superior partial sternotomies, right parasternal incision, right and left mini thoracotomy, right infra axiliary thoracotomy [1,2]. With the encouragement of the minimal invasive surgery improvements were made to minimize the inflammatory effects of extracorporeal circulation, the cannulas were made smaller, and carbon dioxide was employed to the surgical field to lessen the occurrence of air embolism. With the experience accrued in TEE, the complications related to the placements of the cannula was minimized. Preoperative, operative and postoperative problems were easier to detect. Transjugular retrograde cardioplegy cannula placement became feasible. Peripheral cannula and their employment techniques evolved. With port access method endovascular aortic clamp and antegrade cardioplegy were given. As an alternative Chitwood designed the transthoracic direct aortic clamp. Single use cardioplegic solutions such as Custadiol and Del Nido have significantly reduced the extracorporeal circulation time. The difficulties in the early stages related to peripheral cannulation, incomplete deairing, cardiac

techniques during fibrillation and neurological complications due to long extracorporeal circulation times were overcome with the aforementioned progresses and accumulated experience enabling minimal invasive heart surgery to be on par with conventional techniques [2].

Studies have not been able show any difference in mortality rates between the minimal invasive mitral valve surgery and the ones performed by the standard sternotomy [2]. With the improvements, both minimal invasive cardiac surgery and cardiac surgery with conventional sternotomy have been recently considered as standard cardiac surgery [1,2]. Minimal invasive method proved to be as safe as the sternotomy method with the average hospital stay being two days less in the minimal invasive group and again patients in the minimal invasive group were returning to work earlier compared to the sternotomy group. Nevertheless despite being an attractive field for cardiac surgeons, minimal invasive cardiac surgery comes with a hard learning curve [2]. It is recommended that this curve to be completed in a cardiac center with a high circulation [2,3]. In the beginning selection of the patients with less risk factors (patients that do not have big body mass index, do not have aortic insufficiency, and those do not present with complex conditions) would both increase success and motivation [3]. In addition infections due to partial sternotomies and pain related to the use of thoracotomy retractors still continues [1]. And this is leading to new searches, like single port heart surgery [1], periareolar incision [4] being popular again. At present the most popular approach in minimal invasive cardiac surgery, especially for mitral valve surgery is an anterior mini thoracotomy through the 4th intercostal space [2]. Periareolar incision, which has been employed for 53 years by the plastic surgeons, has been employed in cardiac surgery first in 2006 by Poffo [4]. The incision being right over the 4th intercostal space and the fact that the widest space being in the anterior in thoracotomy, all make access to the heart feasible. At the juncture where there is a color change in the periareolar region a perfect scar that can not be seen occurs [5]. This incision can be made at the bottom of the areola (Figure 2F) [5], or on its lateral [6] or on top of it [7] approximately in a 180° shape. Average areolar diameters in Caucasian women is 48 mm, and 33.2 mm in Asian women [8]. This provides the surgeon a 4 to 8 cm wide thoracotomy which renders all the cannulations being done centrally. When the areolar diameter is small (areolar diameter must be above 2.5 cm for a 4 cm thoracotomy) tranaerolar periaerolar (TAPA) zigzag incision (Figure 2B) [9], and enlarging the incision laterally and medial in a inverted œ (Fig 2C) or employing the same incision above of the areola a œ (Figure 2D) [7] , after a normal periaerolar incision between 3 and 9, 5-7 mm from below crescent shaped skin excision can enlarge the incision (Figure 2E) [8]. PAI provides 57% more thoracotomy than the standard thoracotomy. Transareolar PAI (TAPA) provides 39% (112-179 %) more thoracotomy compared with PAI. When an areola with 4 cm diameter is incised along its diameter it confers a 4 cm incision, this increases to 6.28 cm in PAI and to 8.78 cm in TAPA. Notwithstanding advantages of PAI there are concerns about potential problems arising from the breast tissue; galaktore, galaktocel, lactation insufficiency, numbness of the nipple, hypopigmented scar, limited incision diameter due to small areola [10]. These concerns have prevented the technique becoming popular since it was introduced years ago, and has not been accorded its place in the

literature. Even experienced teams [6] prefer PAI in men and inframamarian incision. Although almost all research has been in the plastic surgery realm, studies and efforts related to these concerns have shown that the technique is safe. Ductus exposed to normal air was observed to have bacteria, studies have shown that no infections were detected [9,10]. Both galaktore and galaktocel due the obliterated channels were rarely seen [11]. Difficult lactation is thought to be more related to the type of operation than the incision. Breast augmentation this is seen in 64% of cases, while the figure for patients not having augmentation surgery was 7% [12].

There is no direct relationship between periaerolar incision and nipple areolar complex necrosis. Emphasis has been made about keeping the incision below 180°. Factors related with necrosis are body mass index, smoking and radiotherapy [13]. Since periareolar incision is inferior located and far from the lactiferous channels bacterial colonization is minimum. Since the afferent nerves would be higher related to the incision, sense of the nipple would be preserved [9]. Other studies have also concluded that nipple sense loss either is absent or minimally seen [5,9,10]. Hematoma, keloid or hypertrophic scar formation are not detected [9]. Wound healing is perfect and there is no visible scar. This especially encourages women patients to accept the operation. Both cosmetically and clinically maximum patient satisfaction is obtained (Figure 5) [9]. As a results we suggest that PAI is a safe alternative with the enormous experience of plastic surgery, the experience garnered by the modest numbers of cases in cardiac surgery and the increase in patients' concerns about aesthetics.

The main limitations of this study were retrospective nature and relatively small number of patients. In addition, our study did not include long-term follow-up results. Finally, some procedures used in the study were dependent on the preference and experience of the surgeon rather than randomized or standardized protocols. However, given that there is ongoing debate in the literature and there is no definitive consensus on this issue, we believe that our results will provide contribution to the existing evidence.

In conclusion, our study demonstrated that periareolar incision was a safe, effective and cosmetically satisfactory method for patients undergoing minimally invasive cardiac surgery. However, further prospective large-scale studies are needed to support our results and obtain stronger scientific evidence.

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