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Right Mini-Thoracotomy versus Standard Sternotomy for Surgical Excision of Atrial Myxomas

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ABSTRACT

Introduction: Atrial myxomas are rare benign tumors; causing obstructive or embolic complications, or even death, depending on their site and size. Therefore, once diagnosed, it should be surgically resected. Atrial myxomas are present about 75% in left atrium (LA) and about 15% in right atrium (RA). Early diagnosis is a challenge because of nonspecific manifestations, and sometimes is asymptomatic and may be discovered accidentally during transthoracic echography (TTE).Minimally invasive cardiac surgery (MICS) has benefits over sternotomy include cosmetically, less pain, and shorter total hospital stay.

Materials and Methods: Between January 2011 to December 2020, (50) patients [30 Sternotomy, 20 MICS] underwent surgery for isolated resection of cardiac myxoma. We reported outcomes; cardiopulmonary bypass (CPB) time, aortic cross-clamp (ACC) time, conversion to median sternotomy
(ST), total hospital stay, complications (stroke, renal failure, respiratory failure, reoperation, and infection), pain, patient's satisfaction, recurrence and survival. Follow-up time was from 6-months to 3-years.

Results: There is no significant difference in CPB or cross-clamp time between groups. No minimal invasive (MI) cases required conversion to a median ST. Total hospital stay is shorter in the MI group by 2.2 days (p-value = 0.045). No differences present in morbidity or mortality between two groups.

Conclusions: Surgical resection of atrial myxoma resection by minimal invasive approach is safe, feasible, and favored over sternotomy.

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Introduction:

Cardiac myxoma is the most common primary benign cardiac tumor and resected surgically. However, it can occur within any cardiac chamber; located in LA (75%), RA (15), bi-atrial (2.5%), and very rare in ventricles and valve. Atrial myxomas arise from inter-atrial septum, at the border of fossa ovalis. Depending on size, site, and mobility of myxoma, it gives manifestation of obstruction, embolization, or constitutional symptoms. If myxoma is large pedunculatedand mobile, it can obstruct the valve, and patient was suddenly died.

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Therefore, myxomas should be resected surgically, once diagnosis was confirmed (1).Echocardiography is the most valuable diagnostic imaging technique, moreover, cardiac computed tomography (CT), and cardiac magnetic resonance (CMR) may be needed. Resection of myxomas is safe, with very low mortality and morbidity (2). Early clinical diagnosis is challenged because its manifestations are nonspecific. Clinical manifestations include fever, chest distress, dyspnea, anemia, syncopal attack, or embolism (3) . Large myxomas may be asymptomatic if its growth is very slow (4). Surgical resection is the main treatment of cardiac myxoma and should be performed as soon as possible when diagnosis is established because the risk of embolization or valve obstruction can be occurred at any time(5). The prognosis of cardiac myxoma is favorable after complete resection; its incidence in cardiac surgery is about 0.3%(6). Recent imaging techniques provide more accurate evaluation of size, site, shape, and attachment. So, exploration of all cardiac chambers may not be needed intra-operative. Mini-thoracotomy approach should be recommended as a treatment option (4).

Several cardiac surgical approaches (isolated left or right atriotomy, right atriotomy with trans-septal incision, and bi-atrial approach) and chest incision (sternotomy or mini-thoracotomy) have been used for myxoma resection (7). Myxomas are usually managed by complete excision through standard median sternotomy (SMS). However, unsatisfied cosmetic result, risk of sternal infection and possible complications of SMS are occasionally troublesome. The concept of minimally invasive cardiac surgery (MICS) has been introduced recently to cardiac surgery. MICS has potential benefits such as; increased patient satisfaction, less pain, decreased length of ICU and hospital stays, improved quality of life, and so decreased costs. The safety and efficacy of MICS approach, in comparison to SMS approach, for atrial myxoma resection has proven challenging (8-10).

Materials and Methods

In this retrospective study, we summarized our experience of atrial myxoma resection using two surgical approaches SMS and right anterolateral mini-thoracotomy (RAMT). This study was approved by institutional research ethics committee of Faculty of Medicine at Minia University, and informed consent was signed. A total of 50 consecutive patients undergoing surgery for atrial myxoma resection from January 2011 to December 2020, were included in the analysis. TTE was used to confirm diagnosis (Figure 1).There were 30 patients who underwent resection through SMS and 20 patients through RAMT approach. Patients were selected for either approach according to surgeon's discretion [non-randomized, patient's preference, surgeon experience, availability for peripheral cannulation]. Patients'medical records were reviewed, and we collected preoperative, intraoperative, and postoperative data.

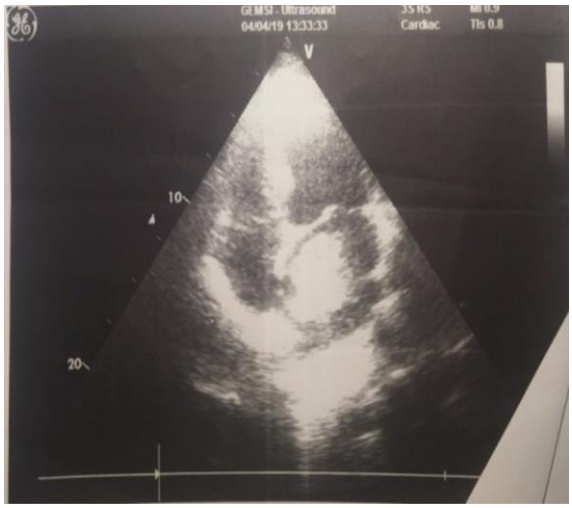

Figure 1: Echographic photo of left atrial myxoma

Surgical techniques

Right anterolateral mini-thoracotomy group (RAMT group)

A double lumen endotracheal tube (ETT) was inserted for single lung ventilation during surgery, not in all cases. Right side of the chest was elevated at an angle of 30°. The intercostal incision was estimated according to the preoperative chest computed tomography (CTA) scan was performed to detect any chest abnormality, aortic tortuosity, and femoral vessels diameter. Generally, RAMT was performed (5-6cm length) in 4th intercostal space (IC)

between anterior axillary and midclavicular lines. In young female patients, a right submammary skin incision was made to avoid injury of mammary gland, and then subcutaneous fat and mammary gland tissue were dissected from the fascia upward to expose 4th rib. After RAMT, the pericardium was opened vertically 2 cm anterior and parallel to right phrenic nerve and extended over the aorta, then suspended to achieve adequate exposure. A 3-cm groin incision was made, and the femoral artery and vein were mobilized. After heparin was given, arterial cannula was placed in the femoral artery (FA), and venous cannula was inserted through femoral vein (FV). The superior vena cava (SVC) was cannulatedpercutaneously through right jugular vein with (16-18 Fr) cannula. Cardioplegic cannula was inserted directly into the aorta through thoracotomy, and CPB was instituted with mild hypothermia. Cold blood cardioplegia was given after the ascending aorta was clamped with a Chitwood clamp through separate 2nd IC incision. Venous drainage was augmented with vacuum assistance applying negative pressures (30 -70 mm Hg) to empty the right side. After the heart was arrested, we incised the RA and atrial septum, and then excise myxoma completely. Carbon dioxide blower was used into the operative field. Cold saline was used to wash the cardiac chambers, and careful inspection was undertaken to ensure complete resection. The atrial septum was repaired by direct running suture or autologous pericardium or Bovine pericardial patch. The right atriotomy was closed using double layer continuous running sutures. De-airing was performed with a needle in aortic root and under TEE guidance. During empty heart, cardiac pacing wires were placed. ACC was removed, and the heart was reperfused. After discontinuing CPB and administering protamine, decannulation was performed. The purse string sutures were tied and FA was directly repaired using 5/0 Prolene, if needed. A single or two chest tubes were placed in right pleural space and pericardium. The mini-thoracotomy incision was closed in the standard fashion (Figure 2).

Figure 2: Photo of post mini-thoracotomy after excision of myxoma

Standard Median Sternotomy group (SMS group)

During induction of anesthesia, the vital signs should be carefully monitored because of hypotension or cardiac arrest due to complete occlusion of cardiac valve. After SMS, CPB was established using aorto-bicavalcannulation, and moderate hypothermia (32°-34°C) was used. Antegrade cold blood cardioplegia was given to achieve cardiac arrest. Right atriotomy was used to excise myxoma in the right side chamber, while additional atrial septostomy was performed in left sided chamber myxoma. Myxomas are soft friable pedunculated or sessile. The pedunculatedMyxoma was excised with its attachment to inter-atrial septum. Intra-operative trans-esophageal echocardiography (TEE) was performed to access residual myxoma, valve competency, and residual trans-septal shunt (Figure 3). The choice of RAMT approach was more common in female gender, low BMI, myxoma size ≤ 5cm, atrial myxoma, and good pulmonary function test (PFT), absence of pleural adhesion, no previous right thoracotomy, no chest deformity, no peripheral vascular diseases and good diameter of femoral vessels. Thepost-operative recovery courses and complications weredocumented. Surgical specimen was sent for pathological examination which was confirmed benign

myxoma (Figure 4). Pre-discharged TTE was performedroutinely, then every 3-month for 3-years follow-up period.

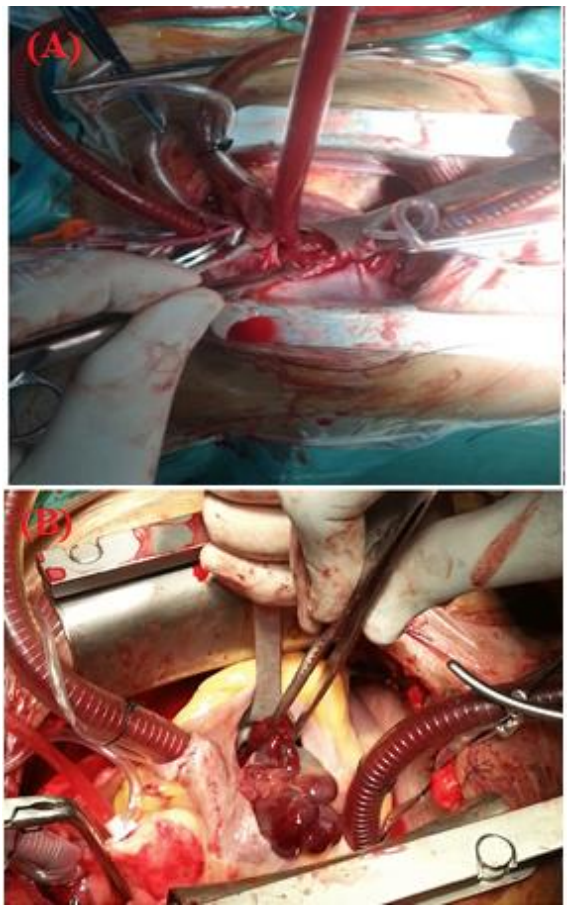

Figure 3: Surgical excision of atrial myxoma through sternotomy.

Statistical analysis

Data was analyzed using SPSS software (version 18, IBM). Quantitative data were presented as mean ± SD (range). Qualitative data were presented as No. (%). Logistic regression was used for univariate analysis of continuous variables. P< 0.05 was considered significant.

Results

There were two groups (30) SMS and (20) RAMT, included in our research with a mean age of SMS group (45±13.5years), and RAMT group (35±15.8 years). Females were equally in each group. The main manifestations included palpitation, shortness of breath (SOB), exercise intolerance, transient syncope, and cerebral embolism. Preoperative atrial fibrillation (AF) present in SMS (4) and RAMT (1). Pre-operative stroke present in SMS (3). Preoperative TTE showed mass, which located in LA (29) in SMS, and (14) in RAMT, followed by RA (1) in SMS, and (6) in RAMT. There were pedunculated mass attached to interatrial septum in (46) cases. The tumor size ranged from (0.5×0.8cm) to (4×6cm). There was associated mitral stenosis (4) in SMS and (1) RAMT.

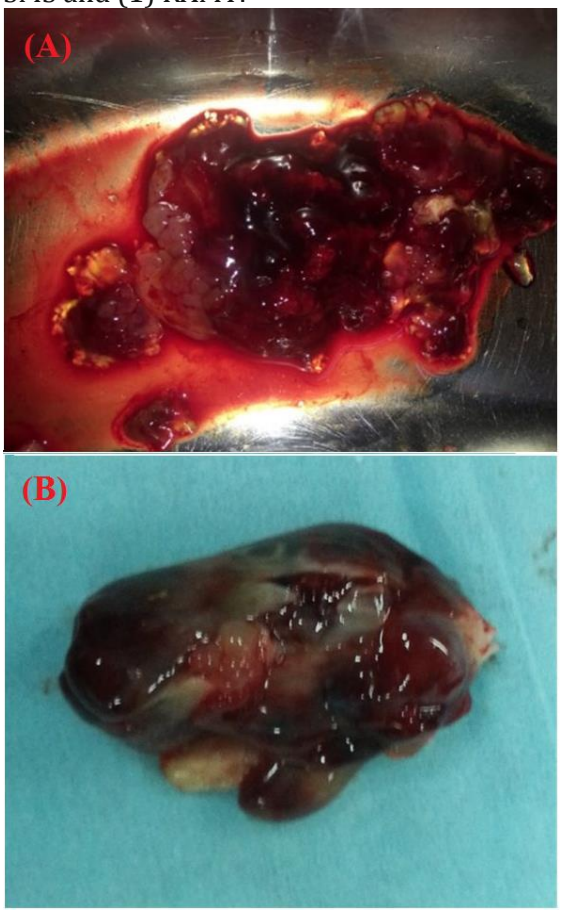

Figure 4: Specimin of excised atrial myxoma.

There were associated tricuspid stenosis in (12) SMS, and (11) RAMT. There was significant correlation between tumor size and NYHA functional class (the correlation coefficient was 0.53, P < 0.001) (Table 1). Also, there was no perioperative death or re-exploration for bleeding or conversion from RAMT to SMS. There were 2 cases of mild wound infection resolved with antibiotics and repeated dressing. There was no significant difference in ACC time, CPB time, mechanical ventilation (MV) time, and wound infection between both groups. There was significant difference between both groups in the duration of ICU stay, chest drainage, blood transfusion, and total hospital stay (Table 2). Finally, Patient satisfaction is one of the reported outcomes, which affects postoperative quality of life.

Table 1: Preoperative clinical data

Variable	SMS (30)	RAMT (20)
Age (years)	45±13.5	35±15.8
Gender (females)	20 (66.6%)	20 (100%)
BMI(Kg/m²)	23.8±3.1	23.3±2.5
HTN	2 (6.6%)	0
DM	1(3.3%)	0
Creatinine (mg/dl)	0.63±0.18	0.65±0.13
Stroke	3(10%)	0
AF	4 (13.3%)	1(5%)
COPD	1(3.3%)	0
NYHA class I	7 (23.33%)	5 (16.6%)
NYHA class II	10 (33.3%)	15 (75%)
NYHA class III	13 (43.3%)	0
TS mild	1 (3.3%)	5 (25 %)
TS moderate	0	1 (5%)
MS mild	2 (6.6%)	1 (5%)
MS moderate	1(3.3%)	0
MS severe	1(3.3%)	0
EF %	66.5±5.8	68.5±3.6
LA myxoma	29(96.6%)	14 (70%)
RA myxoma	1(3.3%)	6 (30%)

Table 2: Intraoperative variables

Variables	SMS	RAMT	P value
CPB (min)	87±25	110±32	0.15
ACC time (min)	47±2	51±2.6	0.67
Mitral Replacement (MVR)	1 (33.3%)	0	0.24
MV time (hr)	10.5 ± 1.1	9.2 ± 2.3	0.37
ICU stay (days)	2±1.5	1±0.5	0.045*
Wound infection	2 (6.6%)	0	0.45
Postop. Chest drainage (ml)	775±260	535±160	0.01*
Blood transfusion	35%	6%	0.029*
Hospital stay (days)	15.3±2.4	7.2±1.6	0.003*

Table 3: Post-operative pain score

Variables	SMS	RAMT	P-value
1st POD	8.8 ± 1.2	6.32 ± 0.65	0.02*
3rd POD	8.5 ± 1.25	5.2 ± 1.3	0.03*
At time of discharge	8.18 ± 1.2	2.4 ± 1	0.04*

The patients discharged uneventfully and recovered well during follow-up. No death, recurrence of myxoma or any complications occurred during 3-years period follow-up period (Table 3).

Discussion

Despite of myxoma is the most common primary cardiac tumors, it remains a very rare, and LA is the commonest site. Cardiac myxoma is more common in females than males, with ratio 2:1.The clinical manifestations of myxoma are widely variable and non-specific. Regardless of presentation, once a diagnosis is made surgical excision is recommended to avoid serious complications (11). So, we recorded few numbers of cases over long period. All patients were discovered incidentally during TTE examination. Myxomas were predominant in females (4:1) and LA.

Patients presented with signs and symptoms associated with secondary embolization in about 30% (12). So, once diagnosis was confirmed, surgical excision was performed to avoid incurable complications.

Bi-atrial exposure has been the preferred approach for complete surgical excision. MI approach has been increasingly used in the field of modern cardiac surgery(4, 6). In our study, we used to right atriotomy trans-septal approach for LA myxomas.

Accurate imaging of cardiac myxomas before surgical resection is essential before operative intervention. Myxomas are often diagnosed with echocardiography, CT, or CMR (7).Echocardiography is a cornerstone of workup in the evaluation of ischemic stroke, where cardiac causes are 15% (13). TTE is the primary imaging technique for diagnosis, and its accuracy is 95%. It provides important information, about tumor like; site, size, number, and pedicle, as well as hemodynamic changes. CT and MRI can provide relation between mass and adjacent intra/extra-cardiac structures, and may help in differential diagnosis(14). We reported only two cases MRI needed for confirmation the diagnosis. Advanced diagnostic imaging helped us to be ensured that, there were not multiple myxomas.

Surgical excision is the treatment of choice for atrial myxoma with result of complete cure in (99%), and recurrence in (1%) (15).The commonest cause of recurrence is incomplete resection of the myxoma attachment area (16-18). So, complete surgical resection is the primary treatment with excellent outcomes without recurrence in our study.

Similar studies are limited, because of the rarity of primarycardiac myxoma, limited exposure of MI approach and possibility of incomplete resection. The safety and clinical efficacy of MI approach are still challenging (14).When compared with a SMT approach, the reported benefits of MICS include reduced; surgical trauma, blood loss, need for reoperation, and less pain, early return to normal daily activity, shorter ICU and hospital stays, reduced costs, and higher level of patient's satisfaction (10, 19). The RAMT approach has the same efficacy and safety as the SMS approach. Additionally, the right minithoracotomy has the advantages of less postoperative chest drainage, blood transfusion, satisfied cosmetic results, and shorter hospital stay, which can be considered as a promising alternative to SMS approach.

RAMT approach proved to be easy to learn and perform whilst maintaining maximum security for patients. The wound was more cosmetic appreance, so patients requested this approach.Besides its better cosmetic result, it can minimize surgical trauma. It had better pain score and wound satisfaction (20).

Conclusions

We concluded that the clinical outcome of the minimally invasive approach for atrial myxoma resection is acceptable; the technique is feasible, and safe for patients.

Study limitations

This study is limited because of its retrospective non-randomized study with small number of patients. Relatively short period of follow-up, and propensity score matching was not used

Abbreviations

SMS: standard median sternotomy, **RAMT:** rightanterolateral minithoracotomy, **TTE:** Trans-Thoracic Echo, **TEE:** Trans-Esophageal Echo, **RA:** Right Atrium, **LA:** Left Atrium, **LV**: left ventricle, **RV** : right ventricle, **CMR/ MRI:** Cardiac Magnetic Resonance Imaging, **CT:** Computed Tomography,**S.Cr.:** Serum Creatinine, **DM:**

Diabetes Mellitus, **HTN:** Hypertension, **BMI:** Body Mass Index, **CPB:** Cardio Pulmonary Bypass, **ST:**Sternotomy, **MI/CS:** Minimal Invasive/ Cardiac Surgery, **SVC:** Superior Vena Cava, **IVC:** Inferior Vena Cava**, ICU:** Intensive Care Unit, **COPD**: Chronic Obstructive Pulmonary Disease, **MR**: mitral regurgitation, **TR**: tricuspid regurgitation, **MVR**: mitral valve replacement, **PFT:** pulmonary function test, **ICT** : Inter Costal Tube, **VAS**:- Visual Analog Score.

Conflicts of interest

The authors have declared no conflict of interest.

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