

MINIMAL INVASIVE MULTIVESSEL CORONARY ARTERY REVASCULARIZATION THROUGH LEFT ANTERIOR MINITHORACOTOMY: A PROMISING FUTURE

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Abstract

ABSTRACT Backgrounds Over decades median sternotomy has been a gold standard approach for treatment of isolated multivessel coronary artery disease but this traditional approach has been associated with sternal wound healing complications leading to remarkable morbidity and mortality. Our aim was to describe our technique of left anterior minithoracotomy through fourth intercostal space for treatment of patients with multivessel coronary lesions. Methods Our experience includes 62 consecutive patients who were operated with the same surgical team. Left internal thoracic artery was harvested in all patients by the aid of rib retractor. All patients were operated under cardiopulmonary bypass (CPB) with blood cardioplegia through left minianterior thoracotomy of 5cm-7cm. All saphenous vein grafts were harvested endoscopically. Results We had no mortality, no early postoperative myocardial infarction was observed. Only one patient was converted to sternotomy (1.6%). Two patients had postoperative atrial fibrillation (3.2%), 1 patient suffered postoperative stroke (resolved without neurologic deficit) (1.6%), 4 patients had revision due to postoperative bleeding (6.4%) performed through the same incision (no sternotomy was required). The mean number of bypass was 3.6 ± 0.8 , cross clamping time was 95.7 ± 41.0 minutes, cardiopulmonary bypass time was 159.2 ± 46.5 minutes, intubation time was 6.7 ± 1.9 hours, intensive care unit (ICU) stay was 1.2 ± 0.6 days, hospital stay was 5.3 ± 2.7 days. Conclusion CABG via left anterior thoracotomy is equally effective as traditional sternotomy but less invasive, quick recovery and is so promising in terms of less morbidity and mortality. It might be an alternative to sternotomy incision and percutaneous techniques

MINIMAL INVASIVE MULTIVESSEL CORONARY ARTERY REVASCULARIZATION THROUGH LEFT ANTERIOR MINITHORACOTOMY: A PROMISING FUTURE

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ABSTRACT

Backgrounds

Over decades median sternotomy has been a gold standard approach for treatment of isolated multivessel coronary artery disease but this traditional approach has been associated with sternal wound healing complications leading to remarkable morbidity and mortality. Our aim was to describe our technique of left anterior minithoracotomy through fourth intercostal space for treatment of patients with multivessel coronary lesions .

Methods

Our experience includes 62 consecutive patients who were operated with the same surgical team. Left internal thoracic artery was harvested in all patients by the aid of rib retractor. All patients were operated under cardiopulmonary bypass (CPB) with blood cardioplegia through left minianterior thoracotomy of 5cm-7cm. All saphenous vein grafts were harvested endoscopically.

Results

We had no mortality, no early postoperative myocardial infarction was observed . Only one patient was converted to sternotomy(1.6 %). Two patients had postoperative atrial fibrillation(3.2%), 1 patient suffered postoperative stroke(resolved without neurologic deficit)(1.6%), 4 patients had revision due to postoperative bleeding(6.4%) performed through the same incision(no sternotomy was required). The mean number of bypass was 3.6 ± 0.8 , cross clamping time was 95.7 ± 41.0 minutes, cardiopulmonary bypass time was 159.2 ± 46.5 minutes,entubation time was 6.7 ± 1.9 hours, intensive care unit(ICU) stay was 1.2 ± 0.6 days, hospital stay was 5.3 ± 2.7 days.

Conclusion

CABG via left anterior thoracotomy is equally effective as traditional sternotomy but less invasive,quick recovery and is so promising in terms of less morbidity and mortality. It might be an alternative to sternotomy incision and percutaneous techniques

Keywords : left anterior mini thoracotomy, cardiopulmonary bypass, coronary artery bypass grafting

INTRODUCTION

Over decades median sternotomy has been a gold standard approach for treatment of isolated multivessel coronary artery disease but this traditional approach has been associated with sternal wound healing complications leading to remarkable morbidity and mortality. However nowadays various minimal invasive techniques have been described as alternative methods for treatment of coronary lesions (1- 3). Due to difficulty of these procedures and long learning curve,hybrid approach have been also described(4, 5).

Our aim was to describe our technique of left anterior minithoracotomy through fourth intercostal space for treatment of all group of patients with multivessel coronary lesions which we recently have been routinely applying to our patients.

MATERIALS AND METHODS

Our experience includes 62 consecutive patients who were operated with the same surgical team between July 2019 to December 2019 at two different medical centres. Our study was approved by the ethical committee board of our hospital and patient consents were obtained. Left internal thoracic artery was harvested in all patients by the aid of rib retractor. All patients were operated under cardiopulmonary bypass (CPB) through left mini anterior thoracotomy of 5cm-7cm. All saphenous vein grafts were harvested endoscopically. Preoperative screening with computed tomography (CT) angiography to determine the safety of peripheral cannulation for cardiopulmonary bypass (CPB) was taken in all patients.

Patients indicated for isolated coronary artery bypass grafting (CABG) are suitable to be operated under this technical procedure. Even patients requiring emergency surgery or having deformities (kyphosis), chronic obstructive pulmonary disease (COPD), decreased fraction expiratory volume (FEV1), low ejection fraction (EF), pericardial or pleural adhesions can be operated under this noble technique. Only redo patients who are candidates for isolated CABG cannot be operated under this technique. Patients with porcelain ascending aorta or peripheral artery disease whereby cannulation may be challenging are relative contraindicative for this technique. Postoperative follow up period of three months for every patient was performed.

Surgical technique(video)

All patients are operated under general anesthesia. Double lumen endotracheal intubation is performed (allowing single lung ventilation). Patients are supine positioned with the left chest anteriorly elevated (**Figure 1B**). Jugular venous cannulation (17F or 19F venous cannula) is usually performed in patients weighing more than 80kg to facilitate venous drainage during CPB. All incisions are marked including thoracotomy incision (fourth intercostal space), sternum, cannulation site including saphenous incision port for endoscopic saphenous vein harvesting (ESVH) (**Figure 1A**). Defibrillating patch pads are positioned in place.

Suitable sites for cannulation are exposed with small incision of about 2cm (femoral artery, femoral vein or subclavian artery). Left anterior thoracotomy incision of about 5-7cm through fourth intercostal space is performed, in women submammary incision is made to reach fourth intercostal space. Pectoral muscles are split and no costal bones are resected, soft tissue retractor is not used. Single lung ventilation is initiated and left thoracic artery is identified ready for harvesting. Standard instruments used in traditional sternotomy are used during harvesting. A special rib retractor (TSI midcab retractor or Delacroix-Chevalier, Sternal ThorAccess MIS Retractor) is used for harvesting of left internal thoracic artery (LITA). LITA is harvested in skeletonized manner under direct vision. After harvesting of distal part of LITA cannulation is performed and CPB is initiated. Proximal LITA is skeletonized harvested under CPB to obtain its full length. All saphenous vein are harvested endoscopically and marked to avoid twisting during proximal anastomosis. Pericardiectomy is performed in double T shape (**Figure 2**) to allow herniation of the heart to the left side. Herniation of the heart to the left allows the aorta to be easily manipulated especially in patients with right deviated aorta. A 6mm thin silk tape is encircled around ascending aorta and aorta is gently pulled to the left side to allow its access where by antegrade cardioplegia circuit is secured with pulse string sutures. A chitwood cross clamp is introduced through anterior axillary line of 2nd intercostal space for clamping of ascending aorta where isothermic (cold) blood cardioplegia solution is given to allow diastolic cardiac arrest. Cardioplegia is given at every twenty minutes and delivered at the end of each saphenous distal anastomosis. To facilitate exposure of target lesion for coronary bypass grafting both left pulmonary veins and inferior vena cava are separately encircled with a thin 6mm silk tape. Exposure of right coronary vessel (RCA) and its branches is done by pulling the encircled tapes of inferior vena cava and pulmonary vein in the direction of patient's lower extremities. Exposure of circumflex artery (CX), left descending artery (LAD) and their branches is performed by pulling the encircled tapes around vena cava and left pulmonary veins to the left side. All anastomoses are performed with standard anastomosis suturing instrument. The chitwood clamp is released and the heart is allowed to beat spontaneously. During placement of ascending aortic partial biting side clamp for proximal anastomosis, the ascending aorta is gently pulled to the left and the right lung is ventilated allowing its PEEP to push the aorta to the left side. Proximal anastomosis are performed with standard instrument used during conventional CABG. Patients are weaned

safely from CPB. The lower part of pericardium is closed . A single left chest tube is placed in position. Usually rib approximation is not required and thoracotomy is closed in layers. During postoperative period standard analgesic drugs(Nonsteroidal anti-inflammatory drugs) are used for pain management.

RESULTS

Preoperative,perioperative,postoperative characteristics are summerized in **Table 1** . We had no mortality, no early postoperative myocardial infarction was observed . Only one patient was converted to sternotomy(1.6 %). LITA was used in all patients(100%). Non of our patients received the use of right internal thoracic artery(RITA). Two patients had postoperative atrial fibrillation(3.2%), 1 patient suffered postoperative stroke(resolved without neurologic deficit)(1.6%), 4 patients had revision due to postoperative bleeding(6.4%) perfomed through the same incision(sternotomy was not required).Bleeding was due to use of clopidogrel during preoperative period mostly in patients who received urgent surgery. The mean number of bypass was 3.6 ± 0.8 , cross clamping time was 95.7 ± 41.0 minutes, cardiopulmonary bypass time was 159.2 ± 46.5 minutes,entubation time was 6.7 ± 1.9 hours, intensive care unit(ICU) stay was 1.2 ± 0.6 days, hospital stay was 5.3 ± 2.7 days.No repeat revascularization,no signs of myocardial infarction was observed during follow up period.

DISCUSSION

Minimal invasive techniques have been proved as alternative way of treatment in patients with coronary vessel diseases. There have been a lot of techniques described as minimal invasive coronary artery surgery but most of these techniques have been treating single vessel diseases(6). Few techniques of minimal invasive technique in treatment of multivessel diseases have been described(7). Considering the long learning curve, expenses involved by minimal invasive techniques in multivessel coronary artery surgery most centers have not been applying these techniques as minimal invasive way of coronary artery bypass surgery.

Our study has fully described an alternative way of treating coronary diseases in multivessel patients via left anterior minithoracotomy. Our technique is equally effective as conventional surgery in terms of mortality, CPB time,CCT time with quick recovery, minimal pain and satisfactory interms of cosmetics. Our tehnique is also feasible and reproducible as it can be routinely applied to all centers with better results. It does not require sophiscated instruments or new ways of myocardial protection. The learning curve is much shorter and adaptable.

The clinical results of this technique is comparable to other results of many techniques of minimal invasive multivessel coronary surgery. Nambala et al have reported as series of 1500 cases in five years with good results(2). Babliak et al have also reported no mortality, 0 % rate of conversion to sternotomy, and low stroke rate resolved without neurologic deficit (3). Our study technique had mortality of 0%, stroke 1,6% resolved without neurologic deficit, conversion to sternotomy of 1,6% and revision rate of 6,5% .

Perioperative results of this technique is almost equal as traditional CABG. Babliaq et al have reported CPB time of 144.1 ± 22.1 minutes, CCT of 82.4 ± 14.2 minutes and total operation time of 258.8 ± 43.9 minutes(3). In our results which were almost similar to these studies,we recorded CPB time of $159,2 \pm 46,5$ minutes,CCT of $95,7 \pm 41,0$ minutes with average bypass number of 3.6 ± 0.8 (range 2-6)

Multivessel coronary artery surgery via left anterior minithoracotomy provides advantages of using different grafts including bilateral ITA with quality anastomosis and configuration(...). Harvesting of RITA through left anterior thoracotomy my be challenging. Robotic assisted RITA harvesting technique can be employed at this juncture. We are also aiming at routinely harvesting RITA through left anterior thoracotomy incision. Radial artery can also be used as a graft during surgery incase RITA is not harvested for surgeons aiming at full arterial revascularization.

Safety during surgery is the most important key for reliability of any surgical procedure. Most maneuvers we apply during surgery such as moving tapes around ascending aorta is under CPB when the heart is decompressed with minimum arterial pressure whereby moving tapes around left pulmonary veins and inferior vena cava are done under cross clamping whereby the heart is empty and flaccid.These enable easy manipulation

with less or no trauma during the maneuver. Anastomosis are done comfortably with standard instruments used in coronary surgery under direct vision of surgical magnifying loopes. Measurement of grafts length to prevent twisting and kinking of these grafts is done under CPB by filling the ventricle to obtain exact length.

Our technique can be applied in all aspects of candidates regardless of lesion location, lesion number, severity of lesion plaque. Patients considered under high risky of coronary surgery such as diabetes, obesity, thorax deformities benefits at high with this technique. Patients with porcelain aorta are relative contraindicated as ‘no touch technique’ may be applied under CPB with arterial revascularization. This is also applicable in conventional surgery to patients with porcelain aorta.

Peripheral artery disease may also be a relative contraindication for our technique as cannulation may be challenging in these patients with peripheral vessel complications. Right axillary artery may be an alternative site for arterial cannulation in patients with severe peripheral artery disease where cannulation is not possible.

Redo CABG is contraindicated as the technical maneuvers may not be accomplished. Severe adhesions which is the most case in Redo patients is also another contraindication for CABG via left anterior minithoracotomy. Limited adhesions in some patients with history of pericarditis can be candidate via our technique.

Limitations of our study

We did not compare our data to traditional sternotomy though our study aimed at describing the technique which uses the same principles of revascularization as traditional sternotomy. Also our data did not include long term outcomes.

CONCLUSION

It is for this reason therefore CABG via left anterior thoracotomy is equally effective as traditional sternotomy but less invasive, quick recovery and is so promising in terms of less morbidity and mortality. Moreover due to being patient cosmetic satisfactory it might be an alternative to sternotomy incision and percutaneous techniques.

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Figure legends:

Figure 1A : Perioperative patient positioning showing femoral access for cannulation and endoscopic saphenous port(ESP)

Figure 1B : Perioperative patient positioning showing chest positioning

Figure 2 : Opening of pericardium

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Tables and figures.pdf available at <https://authorea.com/users/365807/articles/485763-minimal-invasive-multivessel-coronary-artery-revascularization-through-left-anterior-minithoracotomy-a-promising-future>