ACCIDENTAL PLEUROTOMY DURING STERNOTOMY

Dissertation submitted towards partial fulfilment of the regulations

for the award of the degree

M.Ch-BRANCH-I

CARDIOVASCULAR AND THORACIC SURGERY

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MADRAS MEDICAL COLLEGE

CHENNAI-600003

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY

CERTIFICATE

This is to certify that the dissertation entitled "ACCIDENTAL PLEUROTOMY DURING STERNOTOMY" presented here is the original work done by Dr. MANIKANDAN K in the department of cardiothoracic surgery, Madras medical college, Chennai-600003, in partial fulfillment of the university rules and regulations for the award of Branch I M.ch Cardiovascular and thoracic surgery degree under our guidance and supervision during the academic period from 2011-2014.

PROF.DR.R. VIMALA, M.D.,
THE DEAN,
MADRAS MEDICAL COLLEGE,

PROF. DR. K. RAJA VENKATESH M.S., MCh.,
DEPARTMENT OF CARDIOVASCULAR AND THORACIC SURGERY
MADRAS MEDICAL COLLEGE
CHENNAI-600003

DECLARATION

I**, Dr. K .Manikandan**, hereby solemnly declare that this dissertation titled "**Accidental pleurotomy during sternotomy**" was done by me in the department of Cardio-thoracic surgery, Madras medical college, Chennai-600003 during the period from March 2013 to March 2014 under the guidance and supervision of **Prof. Dr.K.Raja Venkatesh,MS,MCh**.,. This dissertation is submitted to the Tamilnadu Dr.MGR.Medical University towards the partial fulfillment of requirement for the award of M.Ch.degree in Cardiovascular and thoracic surgery.

DATE : **SIGNATURE OF THE CANDIDATE**

PLACE:

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I thank my dean Prof. Dr.R. Vimala M.D., for allowing me to conduct this study in this prestigious institution.

I thank Prof. Dr. Raja Venkatesh my beloved teacher and guide for agreeing to help me in this study.and more.

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I thank staff nurses and hospital workers for their support in compiling the data for this study.

I thank my wife and my family for their support.

Table of contents

Accidental pleurotomy during sternotomy

Background

Accidental pleurotomy has been noted during sternotomy for various cardiothoracic surgical procedures. Importance of pleural integrity has been noted in various studies and various methods have been proposed to reduce the incidence of pleurotomy.

Aim

To analyze the usefulness the practice of lung deflation before sternotomy and analyze the factors involved in accidental pleurotomy.

Method

This study was a prospective randomized single blinded study conducted at department of cardiothoracic surgery in Madras medical college during the period of March 2013 to March 2014.A total of 101 cases undergoing sternotomy for various cardiothoracic surgical procedures were included in the study. Randomization was done by anaesthesiolgist drawing a lot. Group A [n=34] underwent sternotomy without lung deflation, Group B [n=40] underwent after 5 seconds of lung deflation and Group C [n=27] underwent sternotomy after 10 seconds of lung deflation. Observations were recorded,tabulated and analyzed.

Conclusions

Deflating or ventilating the lung during sternotomy did not influence the rate of accidental pleurotomy [p-0.13 not significant].

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INTRODUCTION

INTRODUCTION:

Sternotomy is the commonest access route for the surgeries performed on heart and other various mediastinal structures. Although the principles of Sternotomy were known and described by Milton in 1897, it was not widely practiced till 1957. It was Julian and colleagues who proved it to be less painful and useful than a bilateral anterior thoracotomy which was practiced during the early era of open cardiac surgery.

During sternotomy we notice that pleura many a times get opened inadvertently. Although accidental pleurotomy does not interfere with the progression of the intended surgery, it may lead to insertion of chest tube and its related morbidity. Avoiding a chest tube may be prudent in patients with poor pulmonary reserve and will help them in post operative recovery and in early mobilization.

To avoid accidental pleurotomy, various methods has been postulated and none have been found to be effective in reducing its incidence. One of the most common methods employed by cardiothoracic surgeons is to deflate the lung just before commencing the sternotomy and to dissect the retrosternal tissues bluntly using a finger. Direction of sternotomy has been found to be a factor in few studies in reducing the pleurotomy.

However, delaying the sternotomy for few seconds after lung deflation has not been studied previously as a factor to reduce the pleurotomy. Because lung takes a while to deflate after disconnection of the anaesthetic circuit, it may be worthwhile to wait for few seconds before commencing the sternotomy. Hence my study will evaluate whether lung deflation is effective in reducing the incidence of pleurotomy and also whether delaying sternotomy a few seconds will help in reducing the pleurotomy.

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

1. To evaluate the practice of lung deflation in reducing the incidence of pleurotomy.

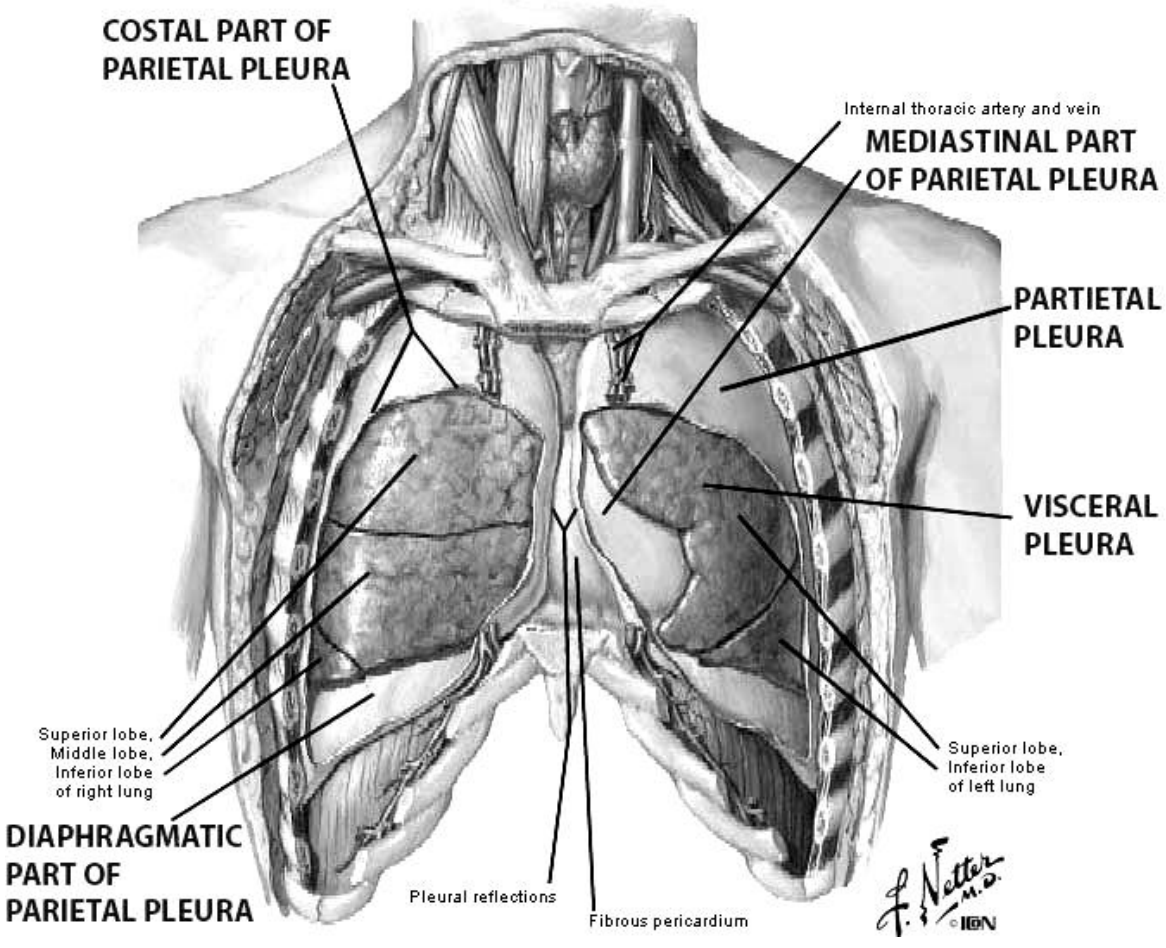
2. To evaluate whether delaying the sternotomy after lung deflation reduces pleurotomy.

3. To understand the various factors which may contribute to the pleurotomy.

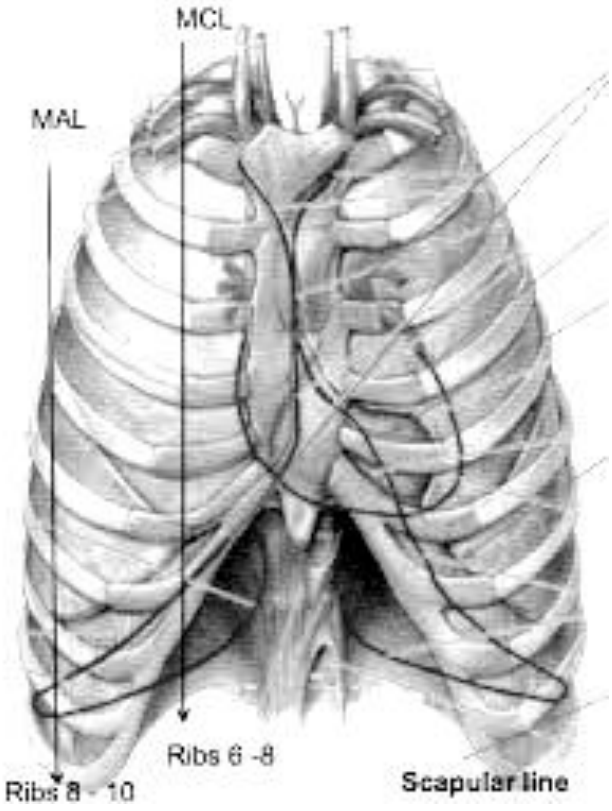
REVIEW OF LITERATURE

Review of literature:

Pleura consist of parietal and visceral layers. Visceral layer closely applied to the lung. Parietal layer lines the costal, mediastinal and diaphragmatic surfaces of the thoracic cavity. Mediastinal pleura and costal pleura meet at the anterior border underneath the sternum. This anterior border of the pleura is not just parallel to the midline but varies in its attachment.



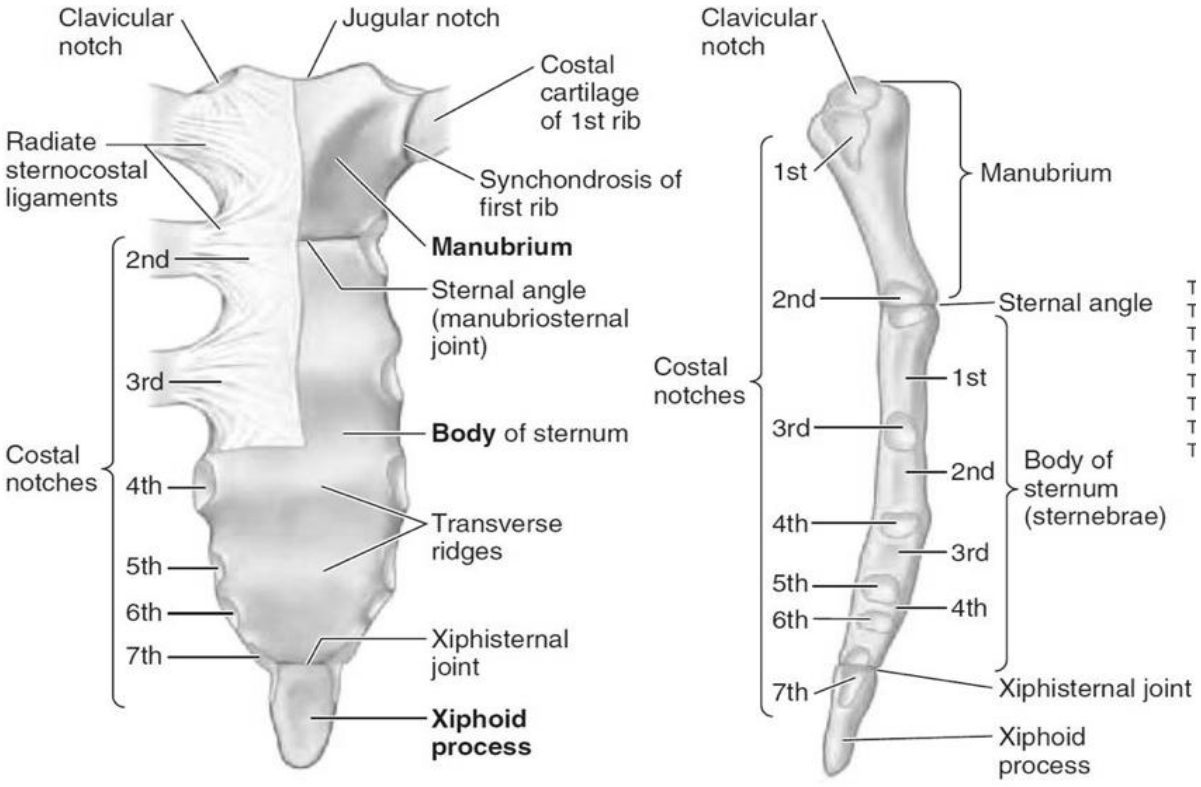
The right and left anterior border of the pleura meet at the sternal angle and then becomes dissimilar in their attachment. The right border traverses downwards close to the midline till the end of the body of sternum. At the level of sixth or seventh cartilage it diverges out to form the inferior border.

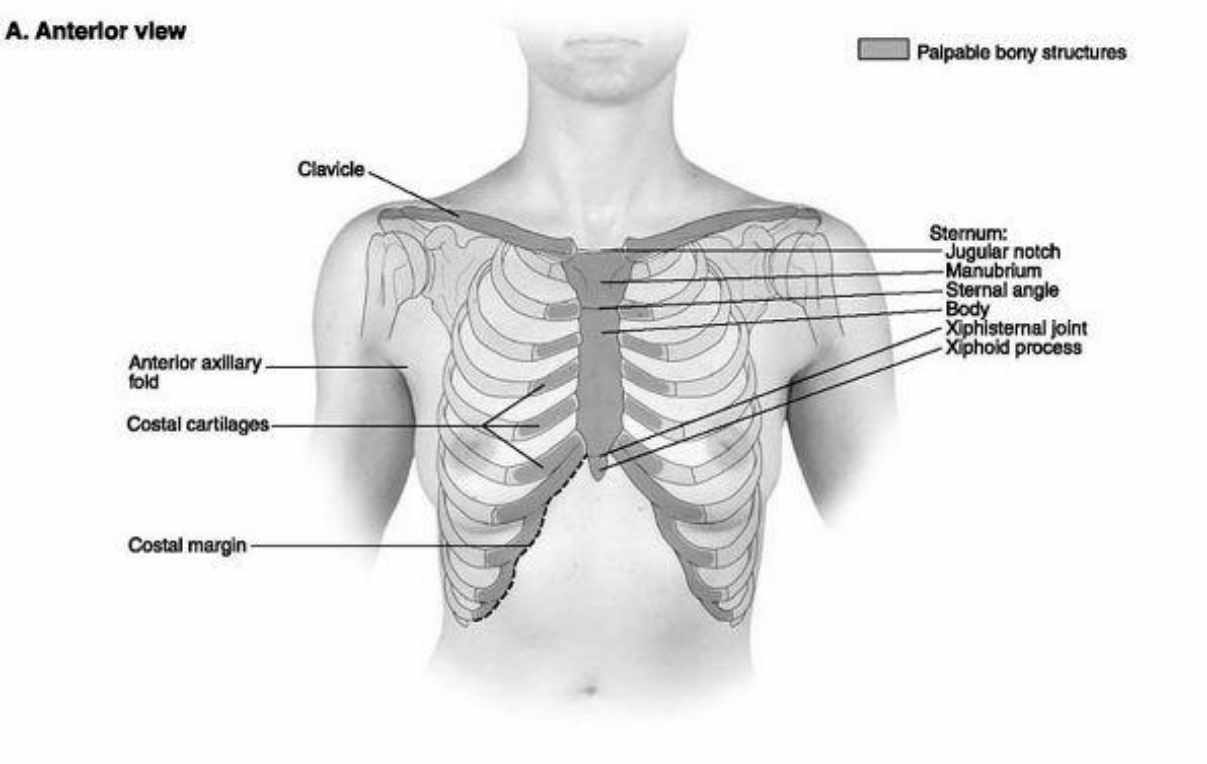


The left anterior border of the pleura on the other hand starts diverging at the level of fourth costal cartilage. It lies at the lateral border of the sternum at the level of fifth costal cartilage, and becomes more lateral at sixth and further after seventh costal cartilage. This lateral displacement of left anterior pleural border between fourth and sixth cartilage is called cardiac notch.

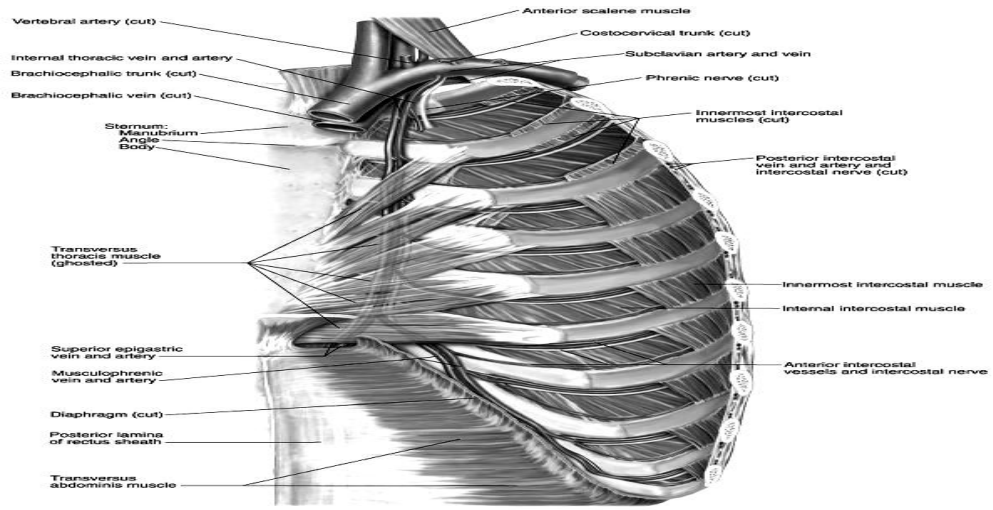
Pleurae have a multitude of functions which include pleural fluid secretion and absorption, lubrication, maintainence of intra pleural pressure, control of infection. These function are maintained normally when the pleural cavity intact. Hence it is important to maintain the integrity of the pleural cavity while doing surgical intervention.

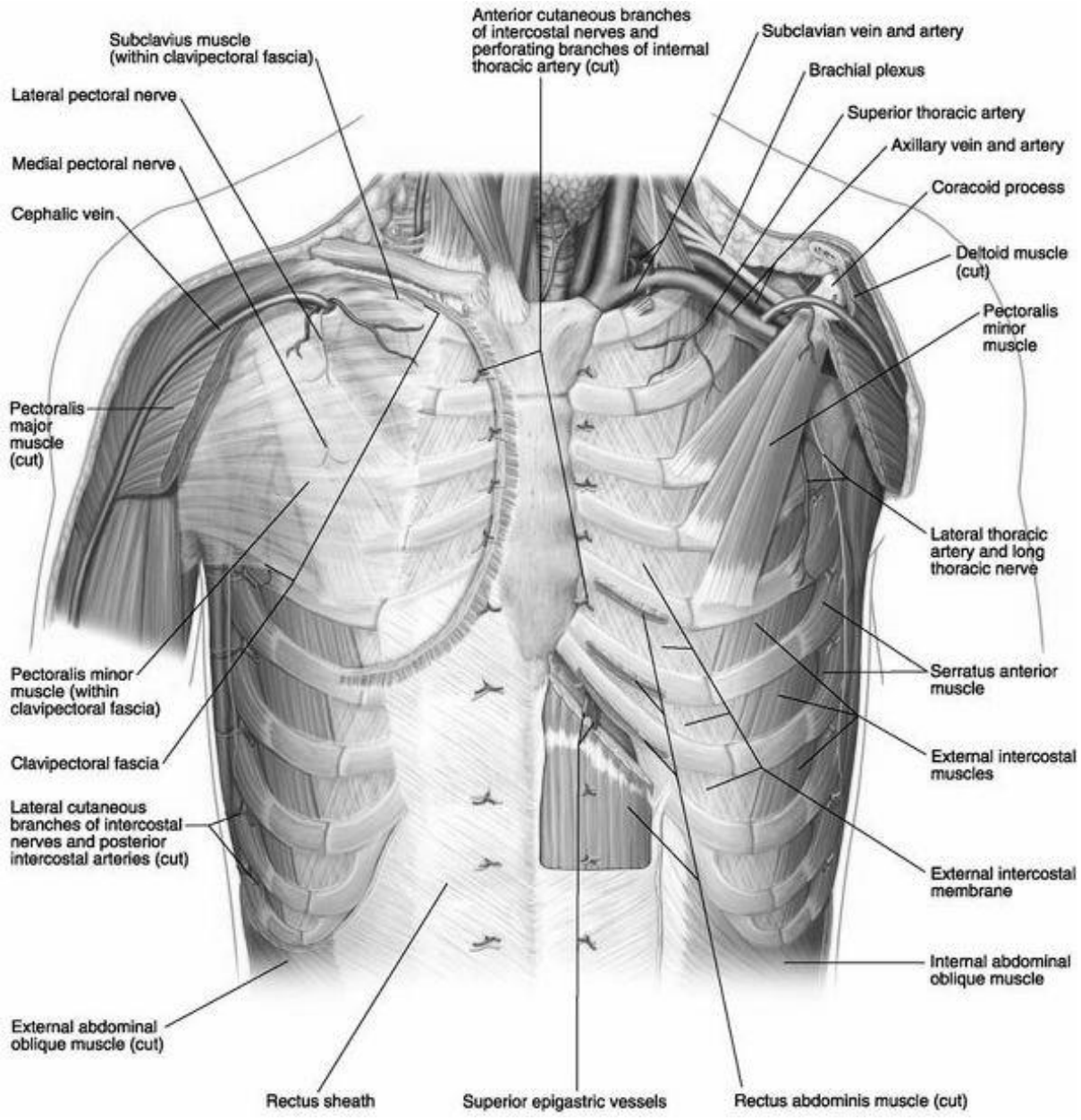
Sternum consists of manubrium, body and xiphoid. It forms articulation with clavicle, ribs and costal cartilages.





Sternum has attachment from pectoral muscles pleura, endothoracic fascia and transverses thoracis muscle , rectus muscles and accompanied by internal mammary vessels on either side and sternal branches arising from them.



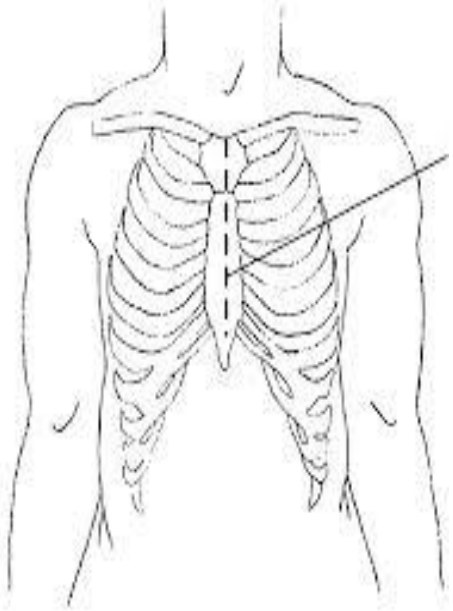


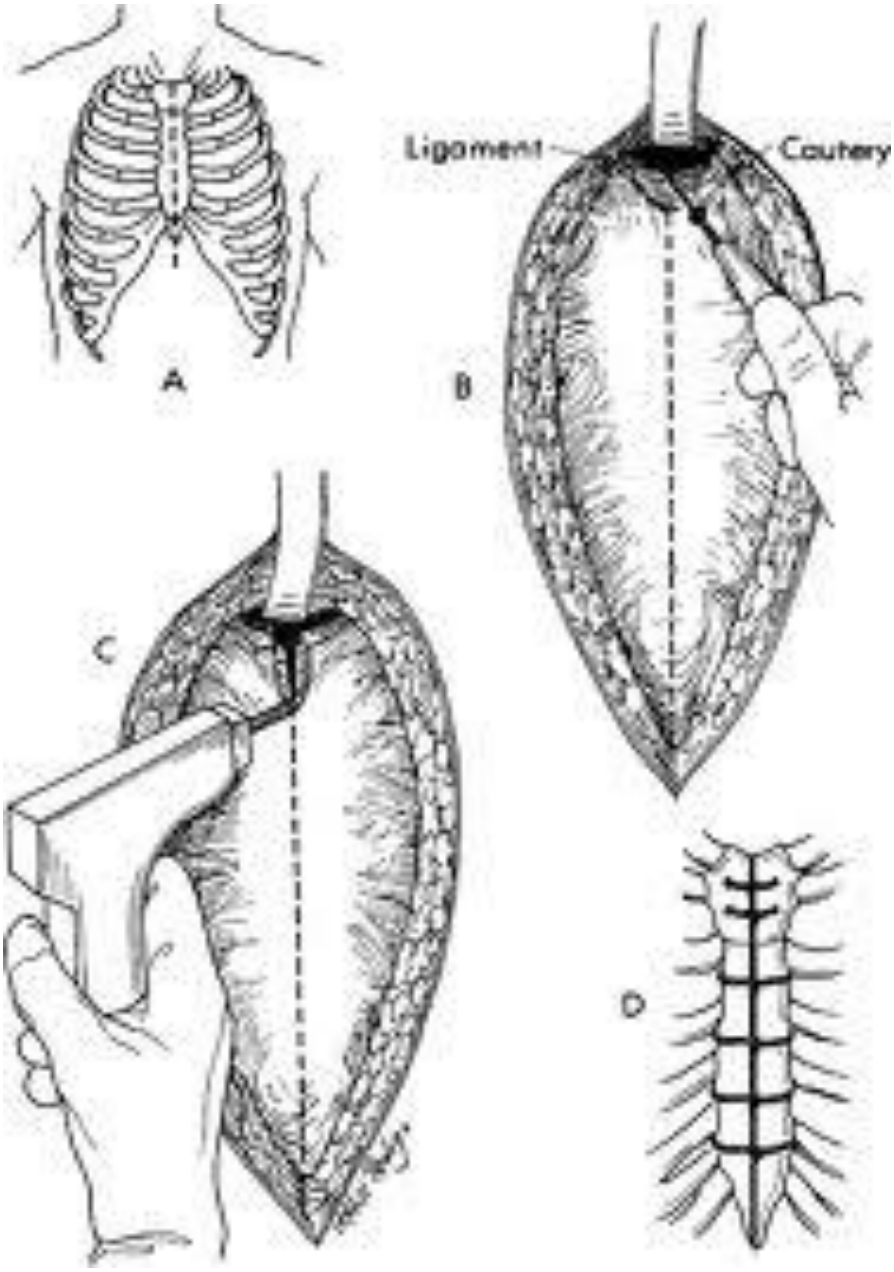
Pictorial representation of attachment to the sternum anteriorly.

Sternotomy was introduced by Milton as an access route for mediastinal structures and was popularised by Julian and colleagues for the cardiac surgeries compared to bilateral anterior thoracotomy done till 1957.

Even after successful open heart surgeries started in 1953, cardiac surgeons were using bilateral anterior thoracotomies for open heart surgeries till Julian O C demonstrated better exposure and better pain control following sternotomies for cardiac surgeries. Sternotomy can be don e in two ways. Either,starting from sternal notch downwards or from xiphoid process upwards.

Sternum can be divided using a electric/pneumatic saw, oscillating saw or by using a gigli’s wire.





Picture showing sternotomy from notch downwards using a saw.

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Inadvertent pleurotomy happens occasionally while doing sternotomy. Incidence of pleurotomy during sternotomy varies in different studies ranging from 7 % to 82 %.

The importance of maintaining the pleural integrity during cardiac surgery has been examined in various studies.

In a study done by Guizilini et al noted a worse pulmonary outcome in patient undergoing CABG using left internal mammary artery in whom pleura was opened.

In a study done by the Lim E et al noted that pleurotomy increased the rate of atelectasis but did not necessarily associate with an adverse outcome.

Atay Y et al in their study noted that the blood loss and post operative blood requirements were higher in the patients with pleurotomy. In addition, pleural effusion, atelactasis, post op mechanical ventilation were lower in patients with pleural integrity.

Similarly Goksin I in their study noted that preservation of pleural integrity reduced post operative bleeding.

Gullu A et al also noted the preserving the pleural integrity provided better pain control during the early post operative period following CABG surgery.

Oz BS et al concluded in their study that pleural integrity after coronary artery revascularisation surgery resulted in better pain control, better respiratory function, and better surgical outcome and reduced hospital cost.

Pleurotomy during sternotomy has been studied in various studies and the possible factors involved in the pleurotomy have been analysed. Direction of sternotomy, surgeon performing the sternotomy, COPD, lung inflation or deflation during the sternotomy and various other factors have been analysed in various studies.

Pick A et al in their centre studied 95 patients undergoing cardiac surgery, and observed pleurotomy incidence. They compared two groups in which the lungs were deflated but sternotomy direction differed. One group underwent sternotomy from xiphoid and another underwent sternotomy from sternal notch. Sternal notch group had 7% and xiphoid up group had 24% incidence of pleurotomy and concluded that xiphoid up group was associated with increased pleurotomy incidence.

Disadvantage of this study was it was randomized and surgeon preference of particular technique of sternotomy over the other.

Lichtenstein SV et al did a single blinded study in which 126 cardiac surgery patients were examined for inadvertent pleurotomy. Anaesthesiologist without the knowledge of the surgeon after randomization either kept the lung inflated or deflated while sternotomy was being performed.

Pleurotomy was noted in 15% of the patients undergoing sternotomy with deflated lungs.9% of patients had pleurotomy with sternotomy with inflated lungs. Sternotomy done above downwards from sterna notch had 21% incidence of pleurotomy. Sternotomy from xiphoid process had 4% incidence of pleurotomy. 92% of the patients had right side pleurotomy.

Ronday M et al in their study noted 15.5.% incidence of pleurotomy with lung deflated and 14% wit lungs inflated. They also noted chronic obstructive pulmonary disease, ventilator usage, demographic factors like age and sex were not relevant to the pleurotomy incidence. In their study incidence of pleurotomy varied from about 6% to 24% among six surgeons.

Stock MC et al in their study had observed the changes in post operative functional residual lung capacity, FEV1,FVC in addition to accidental pleurotomy incidence. Eighty two percent of the patients had accidental pleurotomy which was very high compared to the other studies. There was no significant difference in pulmonary functional test difference between the patients with accidental pleurotomy and those without pleurotomy.This study was a non randomized and only vein only CABG and valve surgeries were included in the study.

All these studies noted there was no significant relationship between incidence of pleurotomy and lung deflation during sternotomy.

Also there was no difference between a sternotomy from sternal notch and sternotomy from xiphoid process with regards to accidental pleurotomy.

There were studies comparing the outcome following intercostal chest drain sub xiphoid pleural drain following cardiac surgery. Guizilini S et al in their study off pump CABG patients had noted that sub xiphoid pleural drain was better than intercostal chest drain in terms of post operative pulmonary outcome.

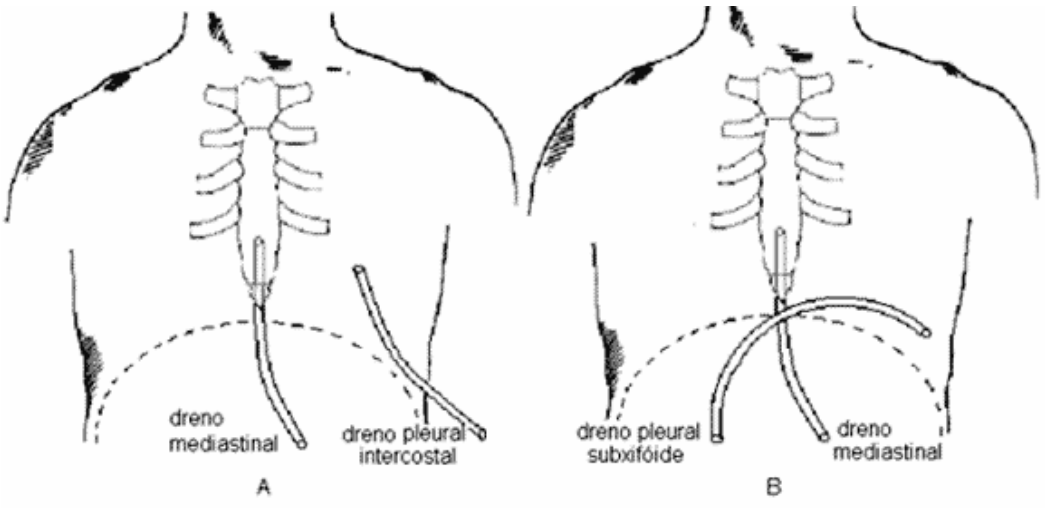

Fig. 1 - Demonstration of the site of the pleural drains. A = pleural drain in the left intercostal region (lateral) and B = pleural drain in the subxiphoid region (medial).

But Onan B et al in their study of 40 patients undergoing coronary artery bypass surgery about the post operative pain and analgesic requirement between patients with sub xiphoid pleural drain and intercostal chest drain. They found there was no difference in clinical outcomes between two groups

Hagl C et al in their study had noted there were less post operative pain and less impairment of pulmonary function following sub xiphoid pleural drain.

MATERIALS AND METHODS

Materials and methods

Study Centre : Department of cardiothoracic surgery, RGGGH, Madras medical college

Duration of the Study : 1 year

Study Design: Prospective randomized study

Methodology (Material &Methods): Patients undergoing sternotomy during the study period will be randomized into three groups. Randomization will be done by anaesthesiologist drawing a lot. One group will undergo sternotomy without lung deflation. Another group will undergo sternotomy 5 seconds after lung deflation. Third group will undergo sternotomy 10 seconds after lung deflation. Pleurotomy incidence and the various other clinical parameters will be recorded and analysed

Inclusion Criteria: All patients undergoing sternotomy

Exclusion Criteria: Patients undergoing repeat sternotomy

Sample Size: Minimum of 25 in each group

Procedure details :

Under general anaesthesia with patient in supine position and sandbag under the shoulder. Standard midline sternotomy will be done with an electric saw after minimal dissection of retrosternal tissues with or without lung deflation according to the randomization. Midline sternotomy may be done either sterna notch downwards or xiphoid upwards according to surgeons preference.

Data Collection and Methods:

Pleurotomy incidence and the various other clinical parameters will be recorded in a proforma.and compiled.

Analysis Plan: Appropriate statistical analytical methods will be used

Sponsorship: NO

Conflict of Interest NO

Proforma

1. Name:
2. Age:
3. Sex:
4. Smoking:
5. COPD:
6. Diagnosis:
7. Surgical procedure:
8. Sternotomy done by:
9. Sternotomy from sternal notch: yes/ no
10. Sternotomy from xiphoid process: yes/no
11. No lung deflation before sternotomy- pleurotomy- yes/no
12. 5 second after Lung deflation- pleurotomy- yes/ no
13. 10 second after lung deflation- pleurotomy- yes/no
14. Chest tube insertion:
15. Sub xiphoid pleural drain:
16. Mediastinal/pericardial drain:
17. Postop morbidity of chest tube/ pleural drain-
18. Chest tube/ pleural drain removal day-

OBSERVATIONS

Observations

Study group was randomized into three groups.,

Group A: Sternotomy with no lung deflation

Group B: Sternotomy after five seconds of lung deflation

Group C: Sternotomy after 10 seconds of lung deflation

GROUP A-:	34
GROUP B:	40
GROUP C:	27
TOTAL NUMBER OF CASES-	101

FIGURE SHOWING CASE DISTRIBUTION PERCENTAGE IN THREE GROUPS

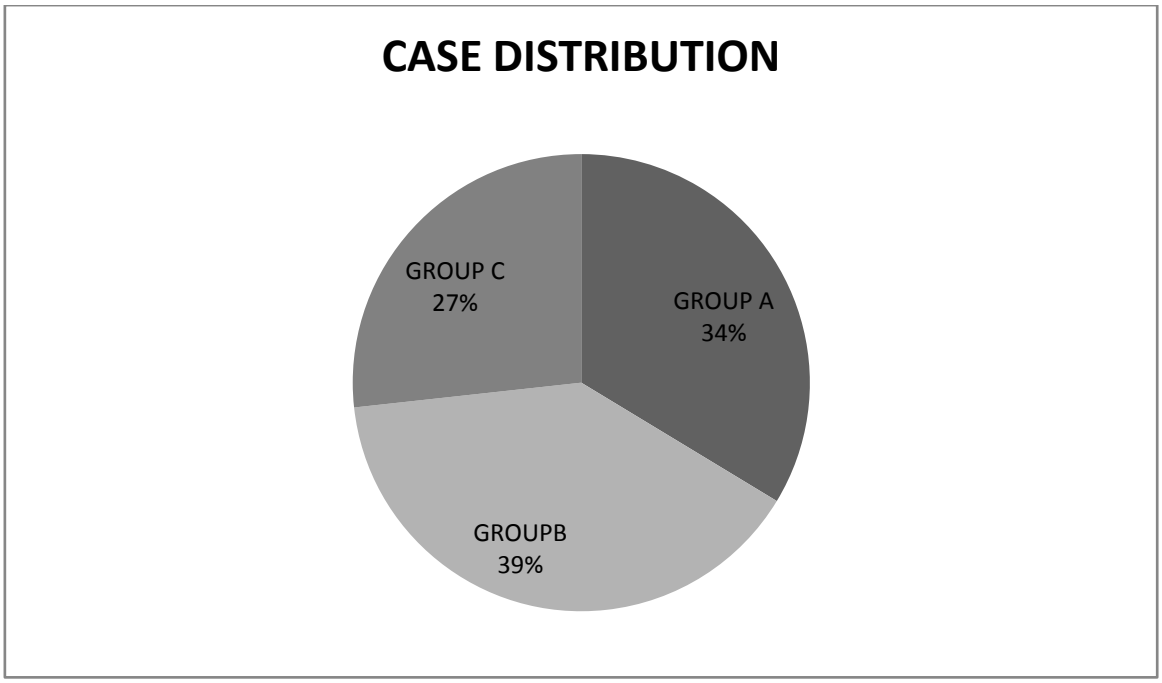

TABLE SHOWING SEX DISTRIBUTION IN THREE GROUPS

	GROUP A	GROUP B	GROUP C
MALE	20	23	16
FEMALE	14	17	11
TOTAL	34	40	27

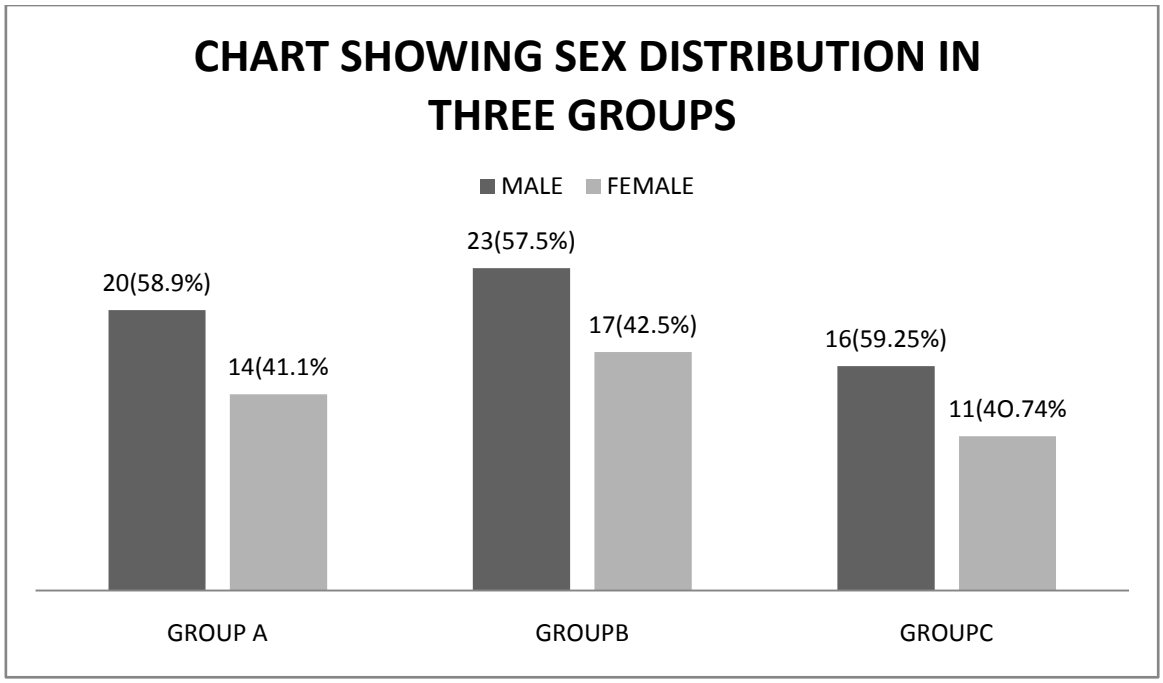

TABLE SHOWING AGE DISTRIBUTION IN 3 GROUPS

	GROUP A	GROUP B	GROUP C
AVERAGE AGE	36.5	39.9	41.7
LOWEST AGE	13	15	16
HIGHEST AGE	60	64	70

All three groups combined

MEAN AGE -39

LOWEST AGE-13

HIGHEST AGE-70

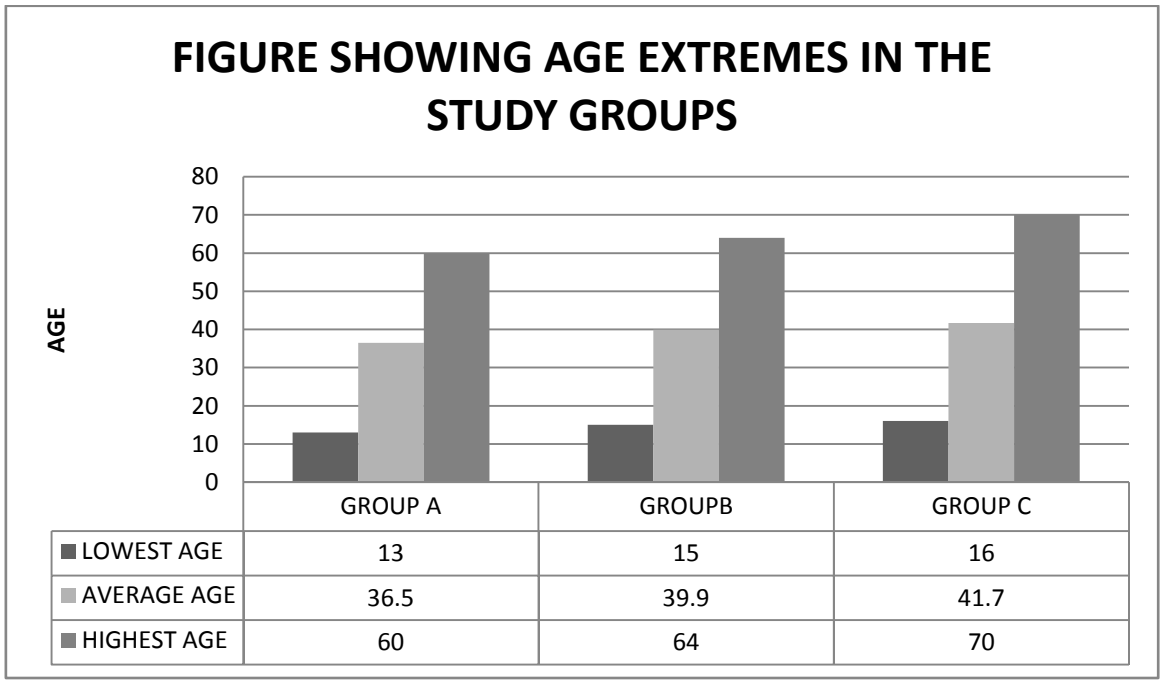

TABLE SHOWING SURGERY TYPE AMONG THREE GROUPS

	GROUP A	GROUP B	GROUP C
MITRAL VALVE REPLACEMENT/REPAIR	10	13	12
DOUBLE VALVE REPLACEMENT	1	2	2
AORTIC VALVE REPLACEMENT	2	4	3
BENTALL PROCEDURE	1	0	1
CABG	8	12	4
MYXOMA EXCISION	0	2	1
ATRIAL SEPTAL DEFECT INTRACARDIAC REPAIR	11	4	2
VENTRICULAR SEPTAL DEFECT-INTRACARDIAC REPAIR	0	1	0
MEDIASTINAL MASS BIOPSY/THYMOMA EXCISION	1	2	1
TRAUMA	0	0	1
TOTAL	34	40	27

FIGURE SHOWING TYPE OF SURGERIES IN GROUP A

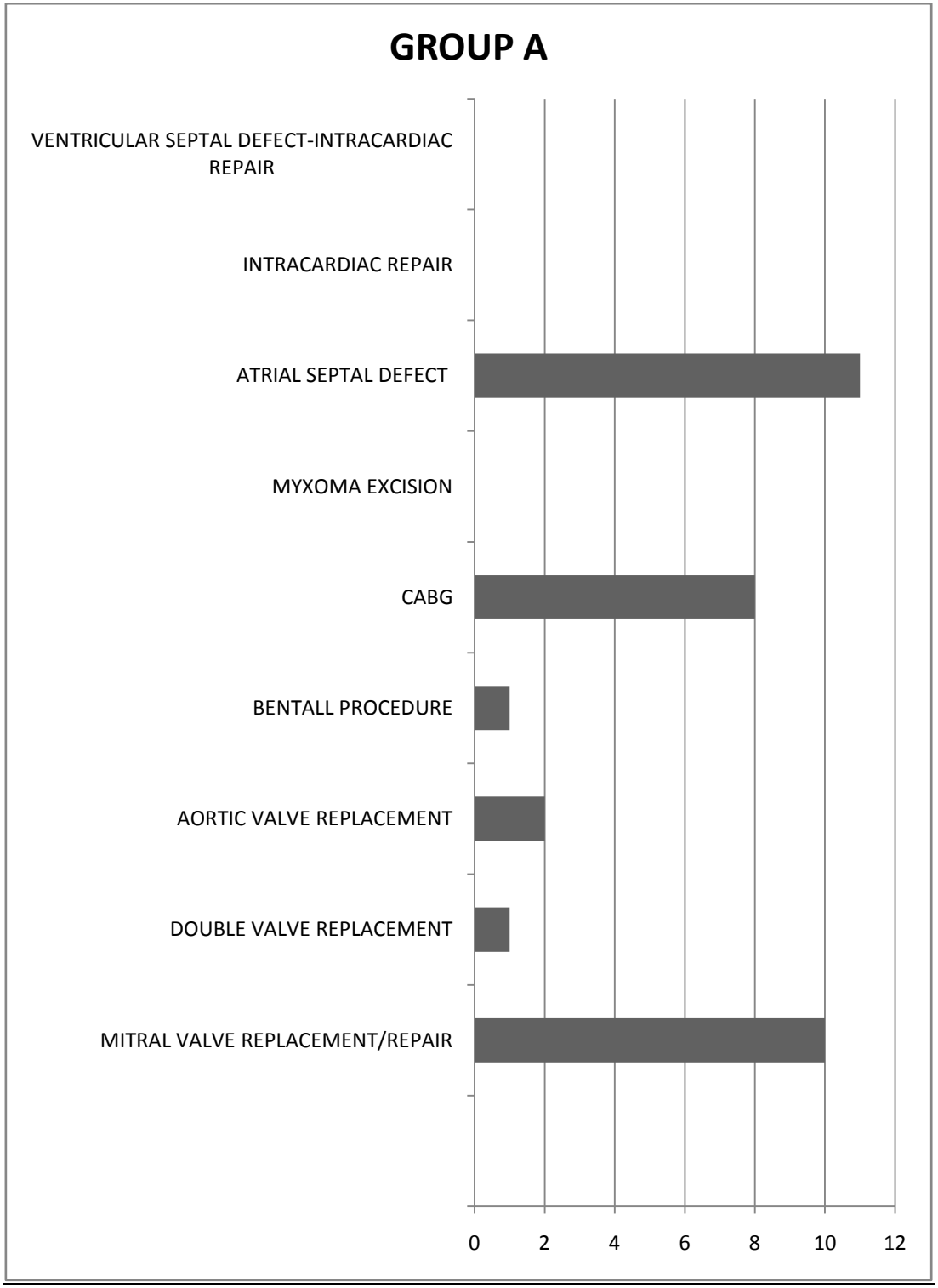

FIGURE SHOWING TYPE OF SURGERIES IN GROUP B

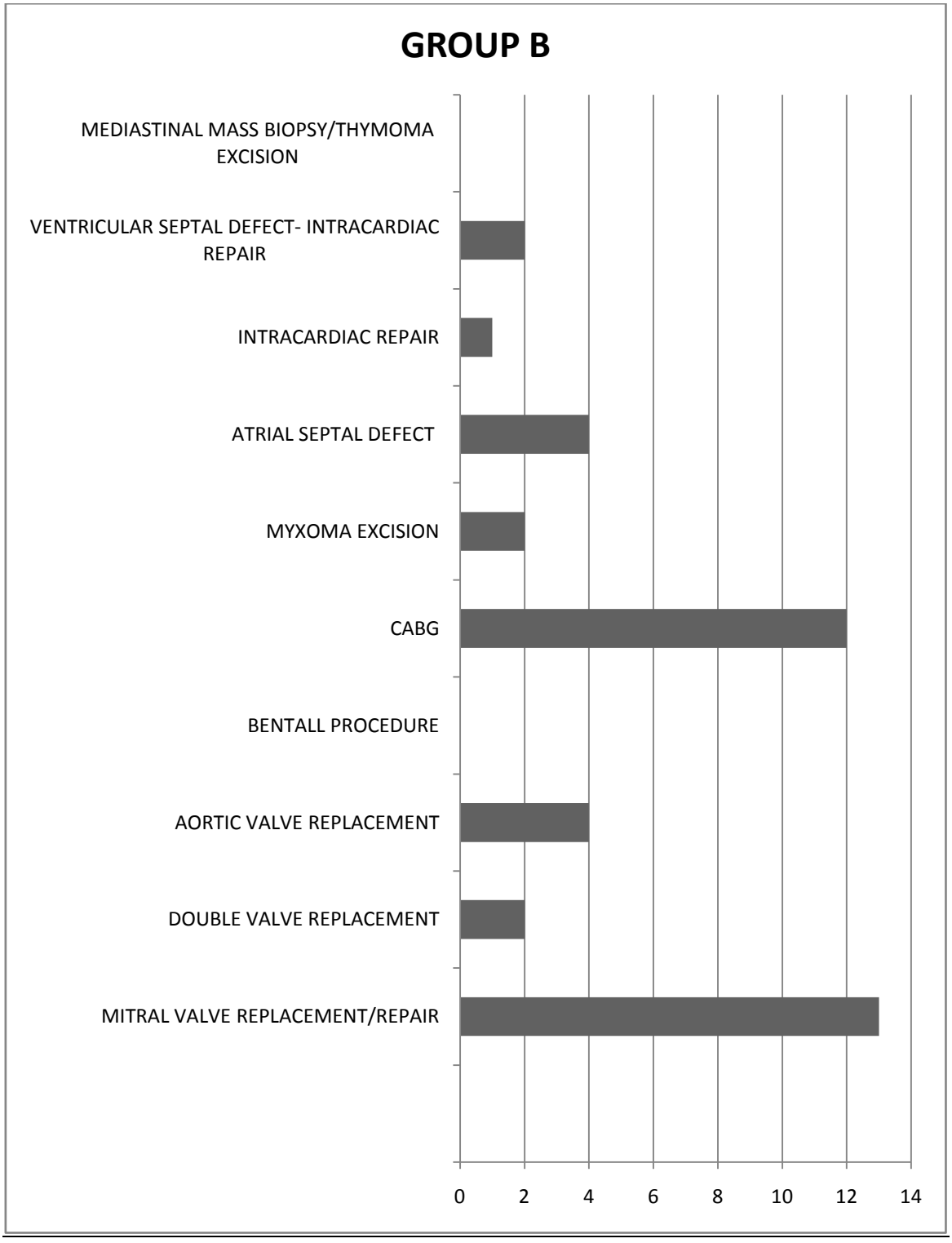

FIGURE SHOWING TYPE OF SURGERIES IN GROUP C

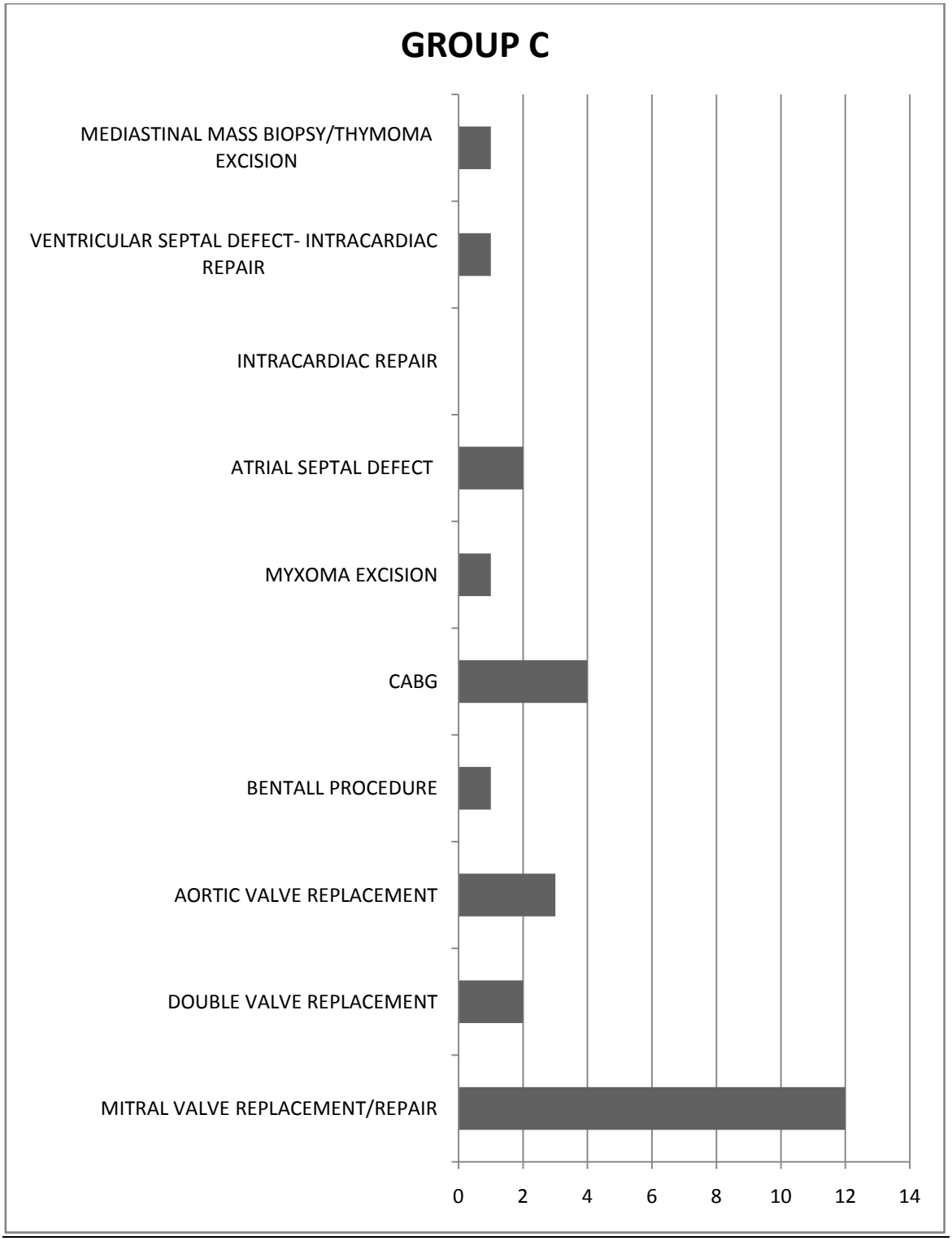

TABLE SHOWING INCIDENCE OF SMOKING AND COPD IN THE STUDY POPULATION

	GROUP A	GROUP B	GROUP C
SMOKING	3	7	3
COPD	1	2	2
TOTAL	4/34	9/40	5/27
PERCENTAGE	11.76%	22.5%	18.51%

Smoking and COPD incidence were similar among 3 groups

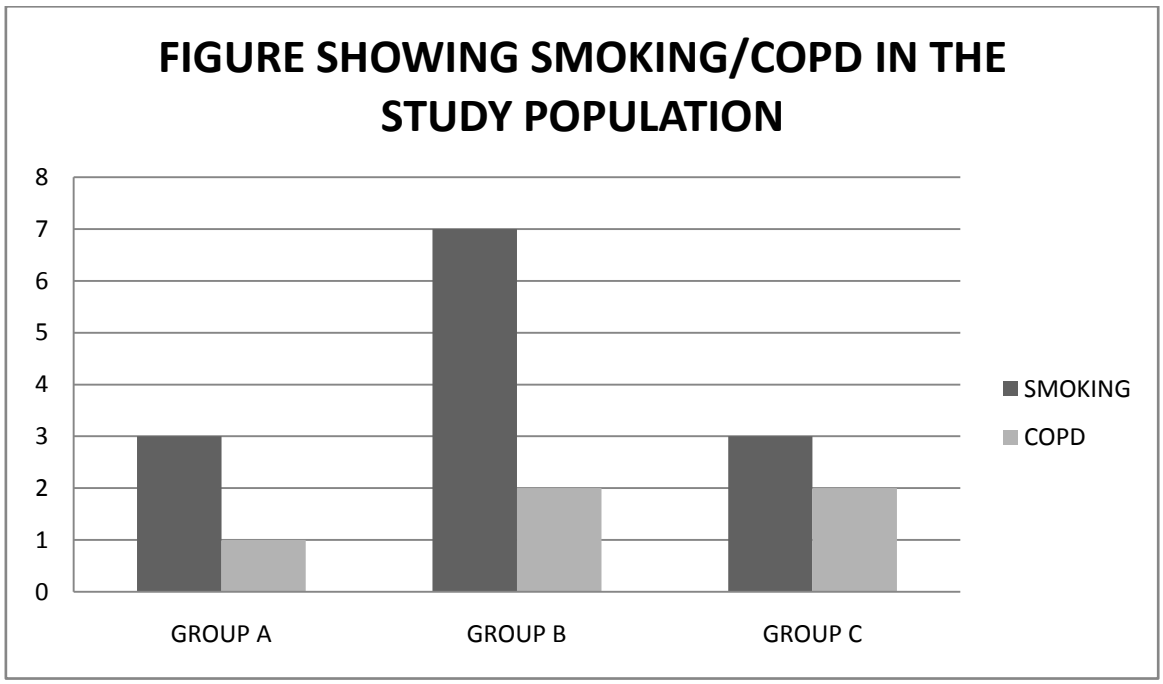

TABLE SHOWING STERNOTOMY DONE BY DIFFERENT SURGEONS IN EACH GROUP

	GROUP A	GROUPB	GROUP C
RESIDENTS	22(64.7%)	25(62.5%)	15(55.56%)
JUNIOR CONSULTANTS	8(23.53%)	8(20%)	5(18.52%)
CONSULTANTS	4(11.76%)	7(17.5%)	7(25.93%)
TOTAL	34	40	27

Majority of sternotomy were done by residents

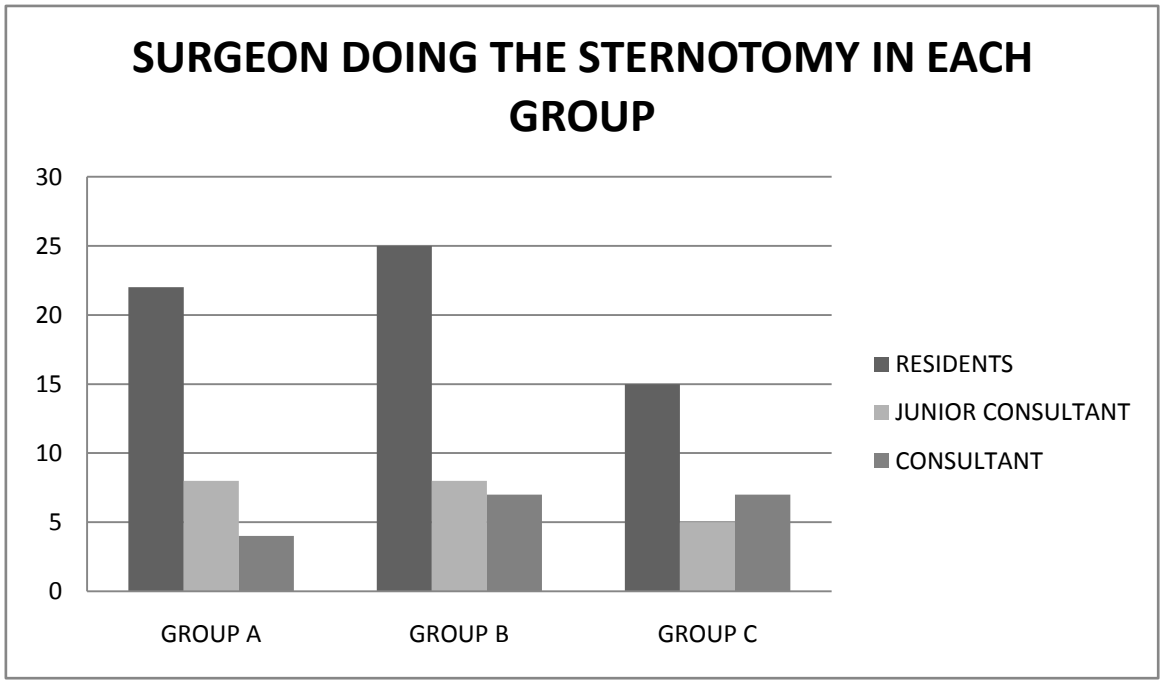

TABLE SHOWING STERNOTOMY TYPE IN THE STUDY POPULATION

	GROUP A	GROUP B	GROUP C
STERNOTOMY FROM NOTCH	34	40	27
STERNOTOMY FROM XIPHOID	0	0	0
STERNOTOMY STARTED FROM NOTCH AND CONVERTED TO XIPHOID UPWARDS	0	2	0

Nearly all sternotomies were from notch downwards.

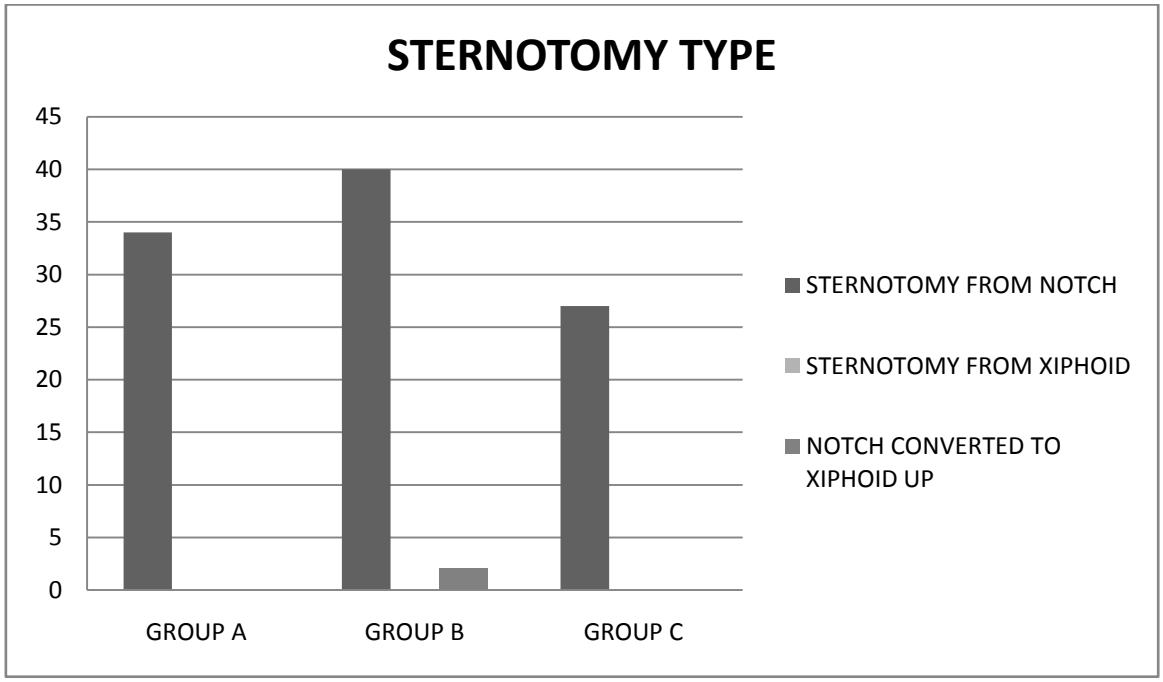

TABLE SHOWING INCIDENCE OF PLEUROTOMY IN PATIENTS WITH COPD AND /OR SMOKING

	GROUP A	GROUP B	GROUP C
SMOKING	1[8.33%]	2[9.52%]	0
COPD	0	0	0
SMOKING AND COPD	0	1[4.76%]	1[12.5%]

Number of smokers and COPD patients were two small to make statistical analysis.

However, 8.33% of patients in group A who had pleurotomy while sternotomy were smokers.

9.52% of patients in group B who had pleurotomy while sternotomy were smokers.

4.76% of patients in group B who had pleurotomy while sternotomy were smoker and had COPD

12.5% of patients in group C who had pleurotomy while sternotomy were smoker and had COPD

INCIDENCE OF PLEUROTOMY AMONG THREE GROUPS

	GROUP A	GROUP B	GROUP C	TOTAL
PLEUROTOMY	12[35.29%]	21[52.5%]	8[38.1%]	41(40.59%)
NO PLEUROTOMY	22(64.71)	19(47.5%)	19(61.9%)	60(59.4%)
TOTAL	34(100%)	40(100%)	27(100%)	101(100%)

Chi square-4.093

Degree of freedom- 2

P value- 0.13- not significant

Yates chi square- 3.02

Yates p value- .22-not significant

The pleurotomy incidence is not related to lung inflation or deflation during sternotomy

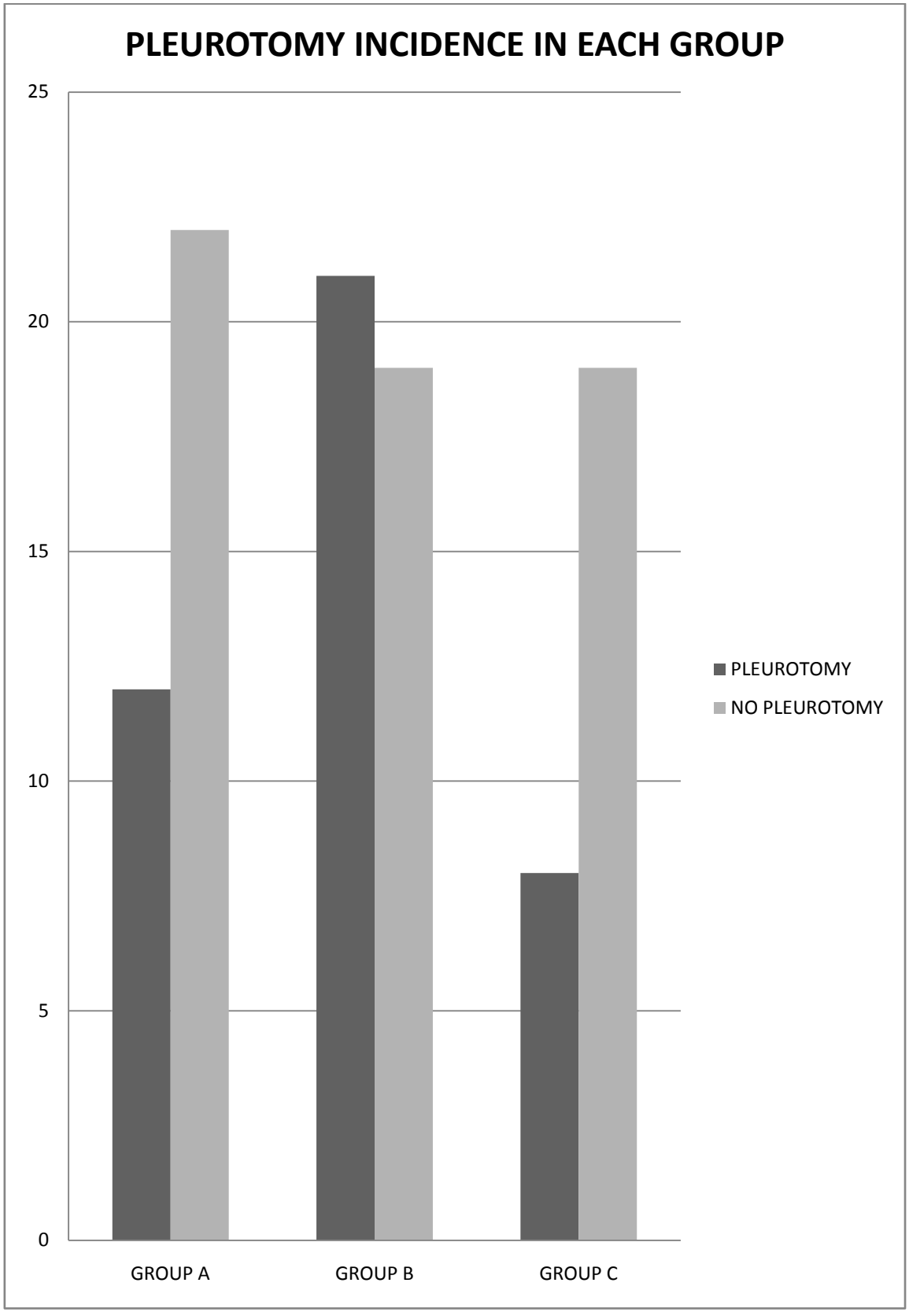
PLEUROTOMY INCIDENCE IN EACH GROUP
25
20
15
10
5
0
GROUP A
GROUP B
GROUP C
PLEUROTOMY
NO PLEUROTOMY

TABLE SHOWING PLEUROTOMY INCIDENCE AND DISTRIBUTION AMONG DIFFERENT SURGEONS

	GROUP A	GROUP B	GROUP C
RESIDENTS	8	14	4
JUNIOR CONSULTANTS	3	2	2
CONSULTANTS	1	5	2
TOTAL	12	21	8

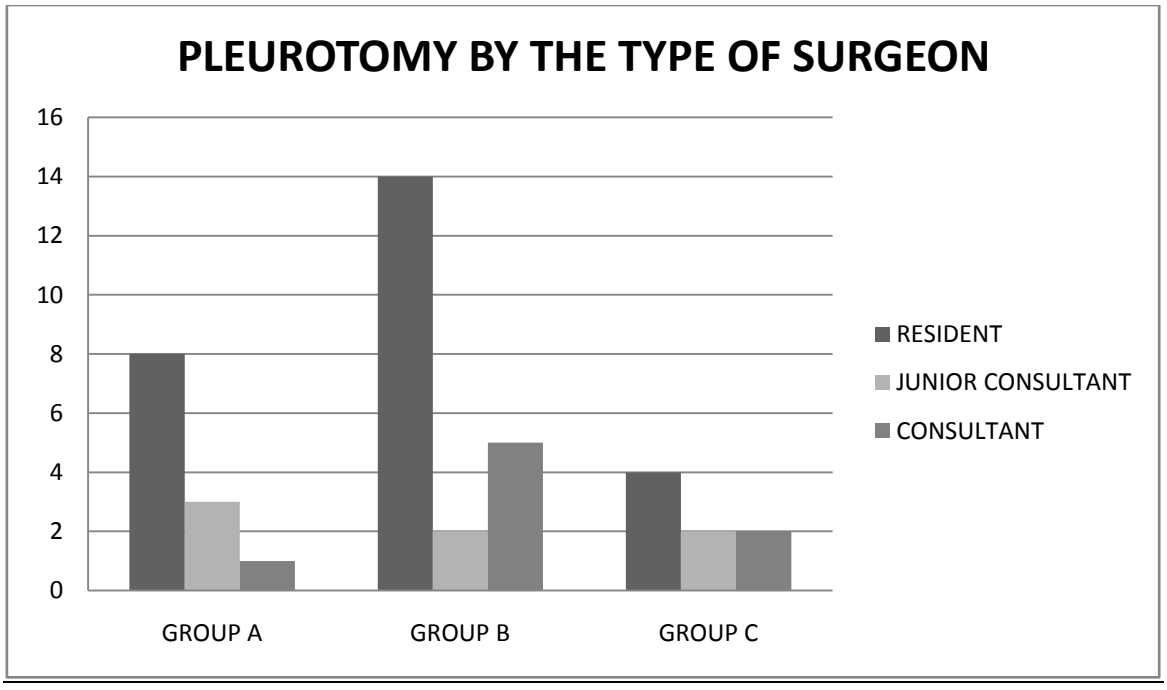

TABLE SHOWING PLEUROTOMY INCIDENCE BETWEEN RESIDENTS AND CONSULTANT/JUNIOR CONSULTANT IN THE THREE GROUPS

	GROUP A	GROUP B	GROUP C	TOTAL
RESIDENTS	8	14	4	26
CONSULTANT / JUNIOR CONSULTANT	4	7	4	15
TOTAL	12	21	8	41

CHI SQUARE-0.771

DEGREE OF FREEDOM-2

p VALUE-0.68- **NOT SIGNIFICANT**

YATES CHI SQUARE-0.18

YATES **P** VALUE-0.91- **NOT SIGNIFICANT**

There is no difference between type of surgeon in causing a pleurotomy

TABLE SHOWING PLEUROTOMY SIDE AMONG THREE GROUPS

	GROUP A	GROUP B	GROUP C
RIGHT	12	21	8
LEFT	0	0	0
TOTAL	12	21	8

100% of the accidental pleurotomies were on the right side.

TABLE SHOWING CHEST TUBE INSERTION ONLY AFTER SURGERY

	GROUP A	GROUP B	GROUP C
INTER COSTAL CHEST TUBE INSERTION ONLY	25	34	23

Intercostal drains were inserted in most of the patients after surgery for presumed better drainage and avoidance of tamponade by electively opening the pleura or enlarging the accidental pleurotomy.

TABLE SHOWING DIFFERENT TYPE OF DRAIN TUBES USED IN THE STUDY

	GROUP A	GROUP B	GROUP C
INTERCOSTAL CHEST DRAIN ONLY	25	34	23
INTER COSTAL WITH MEDIASTINAL/PERICARDIAL DRAIN	0	2	0
MEDIASTINAL/PERICARDIAL DRAIN ONLY	9	5	4*
SUB XIPHOID PLEURAL DRAIN ONLY	0	0	0

Pleura was closed in 1 patient belonging to group C after pleurotomy and mediastinal drains alone were inserted

TABLE SHOWING AVERAGE DRAIN REMOVAL DATE AMONG DIFFERENT TYPE OF DRAINS

	AVERAGE DAY OF TUBE REMOVAL
INTERCOSTAL CHEST DRAIN ONLY	4.1 DAYS
INTER COSTAL WITH MEDIASTINAL /PERICARDIALDRAIN	4.5 DAYS
MEDIASTINAL /PERICARDIALDRAIN ONLY	4 DAYS
SUB XIPHOID PLEURAL DRAIN ONLY	NA

MORBIDITY AND ITS RELATION TO TYPE OF DRAIN TUBE INSERTED

	INTERCOSTAL CHEST DRAIN	MEDIASTINAL/ PERICARDIAL DRAIN	SUB XIPHOID PLEURAL DRAIN
PAIN AT TUBE INSERTION SITE	28	4	0
AIRLEAK	2	0	0
INFECTION	0	0	0
SLIPPAGE	0	0	0
REINSERTION	0	0	0
PROLONGED VENTILATION>3DAYS	0	0	0

Commonest morbidity was pain at the drain insertion site,

TABLE SHOWING DRAIN SITE PAIN COMPARED BETWEEN SUB XIPHOID MEDIASTINAL AND INTERCOSTAL DRAIN

	SUB XIPHOID MEDIASTINAL/PERICARDIAL DRAIN ONLY	INTERCOSTAL PLEURAL DRAIN ONLY	TOTAL
DRAIN SITE PAIN	4	28	32
NO PAIN	14	52	66
TOTAL	18	80	98

Out of remaining 3 patients- one had sub xiphoid pleural drain; two patients had mediastinal plus intercostal chest drain

CHI Square-1.091

Degree of freedom- 1

p value- 0.296 –NOT SIGNIFICANT

Yates chi square-.587

Yates p value-0.44- NOT SIGNIFICANT

There is no difference between the intercostals drain and mediastinal drain in causing drain site pain

DISCUSSION

Discussion

Study population and characteristics

There was an even distribution of 101 cases among the 3 groups. Group A had 34%, Group B-39%, and Group C had 27% of the cases.

Sex mix in the three groups was similar. Males formed 58.95%, 57.5% and 59.25% of the cases in groups A,B and C respectively. Females formed 41.1%,42.5%,40.74% of groups A,B and C respectively.

Surgeries performed in each of the groups were also similar. Mitral valve replacement and ASD closure were the commonest surgery performed in all three groups.

Smoking and COPD

Smoking and COPD did not prove (p value- not significant) to be a significant factor in causing the pleurotomy similar to the study observations done by Ronday M et al.

Sternotomy

The study since conducted in a teaching institution, most sternotomies were done by residents (64.7% in group A, 62.5% in B, 55.56% in group C). Junior consultants performed 23.53%, 25, and 18.5% of sternotomies in group A,B and C respectively.

Consultants performed the lowest number of sternotomies in all three groups. About 11%, 17% and 25% in group A,B and C respectively.

Pleurotomy incidence did not differ among the groups of surgeons(p value – not significant)

Most of the sternotomies were from sternal notch downwards(>98%). In two cases, sternal notch downwards technique changed to xiphoid technique due to difficulty in cutting the sternum above downwards.

Pleurotomy

There was no significant difference between the type of surgeon performing the sternotomy.

Overall incidence of accidental pleurotomy in the study was 40.59%. Literature search had shown a range of 7 to 82% of accidental pleurotomies in various studies.

In the study done by Pick A et al had noted, sternal notch down stenotomy group had lower incidence of pleurotomy. This study cannot confirm this observation since no cases were done exclusively by xiphoid upward sternotomy technique.

One hundred percent of the pleurotomies were on the right side.Lichtenstein V et al in their study noted 92% of the pleurotomies on the right side.

This right side preference of pleurotomy may be related to anterior attachment line difference between right and left pleura. I hypothesise it mayalso be related to the handedness of the surgeon doing the sternotomy. Handed ness of the surgeon may be a factor which can be analysed in afuture study.

Relation of lung deflation to pleurotomy

All the groups (no lung deflation/5 sec deflation/10 sec deflation) had similar incidence of pleurotomy and did not prove to be a factor determining the accidental pleurotomy

This observation was similar to the studies done by Lichtenstein S V et al, and Ronday M et al.

Even ten second deflation proposed in this study did not prove to be a significant factor in determining the accidental pleurotomy.

Type of drain used

All the patients in this study had some form of drain. Intercostal pleural drains were placed in about eighty percent of the cases in this study.

This reflects the institutional preference for intercostals drain with pericardial cut for presumed better drainage of blood and reduced tamponade.

In one patient, pleura was closed and a mediastinal and pericardial drain placed.

Sub xiphoid pleural drain alone was not used in this study.(one patient had in addition to mediastinal drain). Hence this could not be analysed for lesser pain compared to intercostals pleural drain.

Drain removal day

Average drain removal day was about 4 days in all types of drain showing a general institutional preference.

Morbidity due to drain type

Prolonged air leak was present in 2 cases. Drains were removed after 8 days in these cases. Lung injury during the insertion of intercostals drain might be the reason for this complication.

Prolonged ventilation > 3 days were not noted in any of the cases in the study.

Pain at the drain site was the commonest morbidityof all the drain types.

Drain site pain were similar in both sub xiphoid mediastinal and intercostals pleural drain. Statistical analysis showed (p value not significant) no significant difference between the tube types with regards to pain at the drain insertion site.

CONCLUSIONS

Conclusions

1. Age and sex are not a factor determining the accidental pleurotomy during sternotomy.
2. Smoking and COPD also are not found to be a risk factor for pleurotomy.
3. Surgeons experience in doing sternotomy is not a factor determining pleurotomy.
4. Accidental pleurotomy rate in the study is acceptable when compared to similar studies.
5. Right side is involved in all accidental pleurotomies in this study.
6. Direction of sternotomy as a risk factor could not be analysed in this study.
7. Deflating or inflating the lung during the sternotomy did not influence the rate of accidental pleurotomy.
8. Drain site pain is similar in intercostal pleural drain and sub xiphoid mediastinal/pericardial drain.

BIBLIOGRAPHY

Bibliography

1.Dunning J, Prendergast B, Mackway-Jones K. Towards evidence-based medicine in cardiothoracic surgery: best BETS. Interact CardioVasc Thorac Surg 2003;2:405–409.

2.Pick A, Dearani J, Odell J. Effect of sternotomy direction on the incidence of inadvertent pleurotomy. J Cardiovasc Surg 1998;39:673–676.

3. Lichtenstein SV, Abel JG, Miyagishima RT, Ling H, Warriner CB, Stilwell ME, Thompson CR. Effect of lung inflation and sternotomy direction on pleural space violation. Ann Thorac Surg, 1994;58:1734–1737.

4.Ronday M, Damen J, Van der Tweel I. Disconnection of the ventilatory system does not prevent pleural lesions. J Cardio Vasc Anesthesia 1993;7(5):535-537.

5. Dalton ML, Connally SR, Sealy WC. Julian's reintroduction of Milton's operation. Ann Thorac Surg 1992; 53:533.

6.Stock MC, Downes JB, Weaver D, Lebenson IM, Cleveland J, McSweeney TD. Effect of pleurotomy on pulmonary function after median sternotomy. Ann Thorac Surg 1986; 42:441–444.

7.Rostron A, Dunning J, Does deflating the lungs and sawing from the xiphisternum reduce the chance of accidental pleurotomy during sternotomy? Interact CardioVasc Thorac Surg 2005;4:272-274

8 Lim E, Callaghan C, Motalleb-Zadeh R, Wallard M, Misra N, Ali A, Halstead JC, Tsui S. A prospective study on clinical outcome following pleurotomy during cardiac surgery. Thorac Cardiovasc Surg 2002;50(5):287–291.

9.Stock MC, Downes JB, Weaver D, Lebenson IM, Cleveland J, McSweeney TD. Effect of pleurotomy on pulmonary function after median sternotomy. Ann Thorac Surg 1986;42:441–444.

10.Guizilini S,Gomes WJ,Faresin SM,Bolzan E,Carvalho AC,et al.Influence of pleuromtomy on pulmonary function after off pump coronary artery bypass grafting.Ann Thorac Surg.2007;84(3):817-22.

11. Guizilini S,Gomes WJ,Faresin SM,Bolzan DW,Ferraz RF, Tavolaro K,et al. Pleurotomy with sub xiphoid pleural drain affords similar effects to pleural integrity in pulmonary function after off pump coronary artery bypass graft. J Cardiothorac Surg.2012; 7:11.

12. Wheatcraft M, Shrivastava V,Nyawo B, Rostron A,Dunning J. Does pleurotomy during internal mammary artery harvest increase post operative pulmonary complications? Interact CardioVasc Thorac Surg.2005;4(2):143-6.

13.Hagl C,Harringer W,Gohrbandt B, Haverich A.Site of pleural drain insertion and early post operative pulmonary function following coronary artery bypass grafting with internal mammary artery.Chest 1999;115(3):757-61.

14.Atay Y,Yagdi T,Engin C,Ayik F,Oguz E,Alayunt A,et al.Effect of pleurotomy on blood loss during coronary artery bypass grafting.J Card Surg.2009 ;24(2):122-6.

15.Goksin I,Baltalarli A,Sacar M,Sugurtekin H,Ozcan V,Gurses E et al.Preservation of pleural integrity in patients undergoing coronary artery bypass grafting: effect on postoperative bleeding and respiratory function.Acta Cardiol.2006;61(1):89-94.

16.Gullu AU,Ekinci A,Sensoz Y ,Kizilay M,Senay S, Arnaz A et al Preserved pleural integrity provides better respiratory function and pain score after coronary surgery. J Card Surg.2009; 24(4):374-8.

17.Oz BS,Iyem H, Akay HT,YildirimV,Karabacak K, Bolcal C,Demirkilic U, et al.Preservation of pleural integrity during coronary artery bypass surgery affects respiratory functions and post operative pain: a prospective study.Can Respir J.2006;13(3):145-149.

18. Onan B, Guden M, Korkmaz AA, Onan IS, Tarakci I,Fidan F.Subxiphoid versus intercostal chest tubes.Tex Heart Inst J.2012;39(4):507-512.

ANNEXURES

INFORMATION SHEET

Study title : Accidental pleurotomy during sternotomy

Study centre :Department of Cardiothoracic surgery

Madras Medical College & Govt. General Hospital,

Chennai – 600003.

We are conducting a study among patients attending Cardiothoracic surgery department,Government General Hospital, Chennai.•The purpose of this study is to reduce the chance of pleural opening while doing sternotomy for your surgical procedure.We will be doing few measures during sternotomy with aim to reduce the chance of pleural opening. We assure you that your surgical management of your disease will not change because of this study.The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in a loss of benefits to which you are otherwise entitled.

Signature of investigator Signature of participant

PATIENT CONSENT FORM

Study title : Accidental pleurotomy during sternotomy

Study centre : Department of Cardiothoracic surgery
Madras Medical College & Govt. General Hospital,
Chennai – 600003.

Participant name: Age: Sex: I.P.No:

I confirm that I have understood the purpose of procedure for the above study.

I have the opportunity to ask the question and all my questions and doubts have

been answered to my satisfaction.

I have been explained about the pitfall in the procedure.

I have been explained about the safety, advantage and disadvantage of the technique.

I understand that my participation in the study is voluntary and that i am free to withdraw

at anytime without giving any reason.

I understand that investigator, regulatory authorities and the ethics committee will not need

my permission to look at my health records both in respect to current study and any

further research that may be conducted in relation to it, even if i withdraw from the study

.

I understand that my identity will not be revealed in any information released to third parties

or published, unless as required under the law. I agree not to restrict the use of any data or results

that arise from the study.

Signature of the investigator: signature / thumb impression of patient

Name of the investigator: Patient name :

Date: Place:

Ethical committee approval

Turnitin plagiarism

MASTER CHART

JAAGHAVAPATHY	56 M	N	N	RHD/NS	MVR	DR MANIKANDAN	Y		N	N						N	N	Y		N			5
EENIL	38 F	N	N	RHD/NR	MVR	DR MANIKANDAN	Y		N	N						Y	N	N		N			4
CHANDRA	45 F	N	N	MYASTHENIA GRAVIS/THYMOMA	THYMECTOMY	DR AMRITHRAJ	Y		N			N				N	Y	N		N			2
RAJAMANICKAM	49 M	N	N	OAD/DVD/HEPATITIS B	CABG	DR MANIKANDAN	Y		N	N						N	N	Y		N			4
VALLIKANNU	52 M	N	N	RHD/MS/MR	MVR	DR MANIKANDAN	Y		N					Y		R	Y	N		N			3
ALLAMAL	35 F	N	N	RHD/MS	MVR	DR AMRITHRAJ	Y		N			Y				R	Y	N		Y			5
PYYAMMAL	35 F	N	N	RHD/MS/MR	MVR	DR SIGAMANI	Y		N					Y		R	Y	N		N			4
SASIKALA	36 F	N	N	RHD/MS/AR	DVR	DR NANDAKUMAR	Y		N			N					Y	N		N			5
MALLIGA	38 F	N	N	RHD/AS/AR	AVR	DR SIVARAJ	Y		N					Y		R	Y	N		N			3
KAMALAM	35 F	N	N	CKD	CABG	DR NANDAKUMAR	Y		Y			N					Y	N		N			5
MAHESWARI	20 F	N	N	ASD	ICR	DR JANGIDHARSHAN	Y		N	Y							Y					PROLONGED AIRLEAK	8
ERAMASWAMY	61 M	Y	Y	CKD	CABG	DR MANIKANDAN	Y		N	N							Y					PAIN	4
ESWARI	48 F	N	N	RHD/MS	MVR	DR MANIKANDAN	Y		N			Y				R	Y					N	4
CHANNAMOORTHI	40 M	Y	Y	ADPTC ANEURYSM/AR	BENTALL	DR MANIKANDAN	Y		N					Y			Y					N	3
MOORTHI	36 M	Y	N	ASD	ICR	DR AJAY	Y		N	N							Y					N	3
SUBRAMANI	54 M	Y	N	AS	AVR	DR SARAVANAN	Y		N			Y				R	Y					PAIN	3
RANI	45 F	N	N	RHD/MR/AS	DVR	DR MANIKANDAN	Y		N					N			Y					PAIN	4
VELU	51 M	N	N	CONSTRICTIVE PERICARDITIS	PERICARDIECTOMY	DR PREM	Y		N			Y				R	N			Y		N	4
EZHIL	38 F	N	N	RHD/NR	MVR	DR NANDAKUMAR	Y		N	N							N			Y		N	4
MURUGANMAL	35 F	N	N	VSD	ICR	DR AJAY	Y		N			N					Y					N	5
ANGAM	55 F	N	N	RHD/MR/POST CMC	MVR	DR MARIAPPAN	Y		N					N			Y					N	5
MOHAMED ILYASHA	54 M	N	N	AS/AR	AVR	DR MARIAPPAN	Y		N	N							Y					N	5
BALAKRISHNAN	48 M	N	N	CKD	CABG	DR SIVARAJ	Y		N	Y						R	Y					N	5
ESWARI	36 F	N	N	RHD/MS/PHT	MVR	DR SIVASUBRAMANI	Y		N					N			Y					PAIN	4
PREM SHAL	57 M	Y	N	CKD	CABG	DR SIVARAJ	Y		N			N					Y					PAIN	4
JAAGHAVAPATHY	56 M	Y	N	RHD/MS	CABG	DR JANGIDHARSHAN	Y		N	Y						R				Y		PAIN	5
DHANAGOPALADARAI	34 M	N	N	RHD/MS/MR	CABG	DR VINAYAK	Y		N	N										Y		N	4
SUBRAMANI	54 M	Y	N	AS	AVR	DR MARIAPPAN	Y		N			Y				R	N			Y		N	4
NOORJHAN	48 F	N	N	ASD	ICR	DR MANIKANDAN	Y		N					N			Y					N	5
MANOHARAN	47 M	Y	Y	RHD/AS/AR	AVR	DR AJAY	Y		N			N					Y					N	4
ENAKARPAVAKSH	22 M	N	N	ASD	ICR	DR SARAVANAN	Y		N	N							Y					N	3
NATARAJAN	60 M	N	N	CKD	CABG	DR MUTHU	Y		N			Y				R	Y					N	5
PACHAMMAL	48 F	N	N	LA MYXOMA	EXCISION	DR PRABAKAR	Y		N					N			Y					N	4
KARUPUSWAMI	38 M	N	N	RA MASS	NEAR TOTAL EXCISION	DR MANIKANDAN	Y		N			N					Y					N	5
ABDUL HASSAN	58 M	N	N	CKD	CABG	DR MANIKANDAN	Y		N			N					Y					PAIN	5
KANAGARAJ	34 M	N	N	VSD	ICR	DR PREM	Y		N	Y						R				Y		PAIN	4
EELAVARASI	45 F	N	N	ADPTC ANEURYSM/AR	BENTALL	DR NANDAKUMAR	Y		N	Y										Y		N	3
MURUGADOSS	47 M	N	N	CKD	CABG	DR JANGIDHARSHAN	Y		N			N					Y					N	5
HARIKRISHNAN	62 M	N	N	CKD	CABG	DR SIVASUBRAMANI	Y		N			Y				R	Y			Y		N	4
SHARMILA	33 F	N	N	RHD/MR	MVR	DR SIGAMANI	Y		N					Y		R	Y					N	3
MANOHARAN	38 F	N	N	MESOTHELIMAS	BIOPSY	DR MARIAPPAN	Y		Y			Y				R				Y		N	3
KALA	42 F	N	N	MYASTHENIA GRAVIS/THYMOMA	THYMECTOMY	DR MANIKANDAN	Y		N	N							Y					PAIN	5
PARAMATHI	23 F	N	N	MS/AR	DVR	DR AJAY	Y		N			Y				R	Y					PAIN	4
DEVENDRAN	38 M	N	N	MESOTHELIMAS	BIOPSY	DR SARAVANAN	Y		N					N						Y		PAIN	5
VALLIAMMAL	52 M	N	N	RHD/MS/MR	MVR	DR NANDAKUMAR	Y		N			N					Y					PAIN	4
HAJEERA BEGUM	53 F	N	N	VSD/DCMV	ICR	DR MUTHU	Y		N	N							Y					PAIN	3
PAKKIRIZCHI	38 F	N	N	MR	MVR	DR MARIAPPAN	Y		N	N							Y					N	4
NAGARAJAN	58 M	N	N	CKD	CABG	DR NANDAKUMAR	Y		N			N					Y					N	5
HEMANATHAN	36 M	N	N	STAB INJURY CHEST/SVC INJURY	STERNOTOMY	DR MANIKANDAN	Y		N					N			Y					N	5
LATHA	44 F	N	N	MR/TR	MVR/TRICUSPID REPAIR	DR NANDAKUMAR	Y		N			Y				R	Y					N	4
ANANTHAGHANI	35 M	N	N	RHD/MS	MVR	DR PRABAKAR	Y		N	Y						R	Y					N	4
BOOPATHY	39 M	N	N	RHD/AR	AVR	DR PREM	Y		N					Y		R				Y		N	4
RAJA	34 M	N	N	RHD/MS	MVR	DR MANIKANDAN	Y		N			Y				R	Y					N	5
RASHITHA BEGUM	36 F	N	N	RESIDUAL VSD/TE	ICR/EXCISION	DR MUTHU	Y		N	Y						R	Y					N	5
RAJAMANICKAM	56 M	Y	N	CKD	CABG	DR PRABAKAR	Y		N			N								Y		AIRLEAK	8
EESAR	39 M	N	N	AS/AR	AVR	DR MANIKANDAN	Y		N					N			Y					PAIN	5
MYHAMAL	35 F	N	N	RHD/MS	MVR	DR MARIAPPAN	Y		N	N							Y					PAIN	5
CHINJU	36 M	N	N	ASD	ICR	DR NANDAKUMAR	Y		N			Y				R	Y					N	4
UDHAYAKUMAR	45 M	N	N	RHD/MS/MR	MVR	DR GANESAN	Y		N					N			Y					N	4
VENKATESAN	36 M	N	N	ASD	ICR	DR AJAY	Y		N	N							Y					N	4
LAKSHMI	45 F	N	N	RHD/MS/AR	DVR	DR PRABAKAR	Y		N	Y						R	Y					N	3
PUNNYAKUMAR	51 M	N	N	RHD/MR	MVR	DR SIVARAJ	Y		N			N					Y					N	3
RAJDAN	56 M	N	N	ASD	ICR	DR JANGIDHARSHAN	Y		N					N			Y					PAIN	5
CHINTHAMANI	49 F	N	N	RHD/MS	MVR	DR SARAVANAN	Y		N			Y				R	Y					N	4
RAMJABIBI	58 F	N	N	ASD	ICR	DR SIVASUBRAMANI	Y		N	Y						R	Y					PAIN	4
HARI	64 M	Y	Y	CKD	CABG	DR MARIAPPAN	Y		N			Y				R	Y					PAIN	3
MADHAVI	45 M	N	N	CKD	CABG	DR AJAY	Y		N					Y		R	Y					N	5
MOTHIVEL	35 F	N	N	RHD/MS	MVR	DR MANIKANDAN	Y		N					N			Y					N	4
THIRUMANIMUTHU	56 M	N	N	CKD	CABG	DR MANIKANDAN	Y		N			Y				R	Y					N	5
SHANTHI	57 M	N	N	ASD	ICR	DR MANIKANDAN	Y		N	N							Y					PAIN	5
LALITHA	55 F	N	N	MS/AR	MVR	DR AJAY	Y		N			Y				R	Y					PAIN	3
SHANKUMAR	35 M	N	N	RHD/MS	MVR	DR MARIAPPAN	Y		N					N			Y					N	4
ELANKARAN	38 M	N	N	MRS	MVR	DR JANGIDHARSHAN	Y		N			Y				R	Y					N	3
LATHA	38 M	N	N	MRS	MVR	DR SARAVANAN	Y		N	Y						R				Y		N	5
SURESH	38 M	N	N	RA MASS	EXCISION	DR NANDAKUMAR	Y		N			N								Y		PAIN	5
SARADAMOTHY	45 F	N	N	RHD/MS/MR	MVR	DR PREM	Y		N					N			Y					PAIN	4
MANJULA	38 F	N	N	MR	MITRAL VALVE REPAIR	DR GANESAN	Y		N			Y				R	Y					N	4
MANIKANDAN	34 M	N	N	RHD/MS	MVR	DR MANIKANDAN	Y		N	N							Y					N	4
EEVITHA	33 F	N	N	MR	MVR	DR MUTHU	Y		N			N					Y					N	4
SANAYATHY	70 M	Y	Y	CKD	CABG	DR JANGIDHARSHAN	Y		N					N			Y					N	5
CHINNAZAGAN	42 M	N	N	CKD	CABG	DR JANGIDHARSHAN	Y		N			N					Y					N	6
VIDHYA	33 F	N	N	VSD/DCMV	ICR	DR VINAYAK	Y		N	N							Y					N	4
KANNAMMA	55 M	N	N	AS/AR	AVR	DR SARAVANAN	Y		N	N							Y					PAIN	4
KANNAN	60 M	N	N	RHD/MS	MVR	DR AJAY	Y		N					N			Y					PAIN	3
GOWRI	37 F	N	N	RHD/MS	MVR	DR MANIKANDAN	Y		N			N					Y					PAIN	4
SUMATHI	22 F	N	N	RHD/MR	MVR	DR NANDAKUMAR	Y		N	N										Y		N	3
KANNAN	57 M	N	N	CKD	CABG	DR PRABAKAR	Y		N	Y						R	Y					N	5
ELIZABETH	38 F	N	N	CKD	CABG	DR NANDAKUMAR	Y		N			Y				R	Y					N	5
SHALINA	36 M	N	N	CKD	CABG	DR MANIKANDAN	Y		N					N			Y					PAIN	5
SAMYKANNU	35 M	N	N	RHD/MS/MR	MVR	DR MARIAPPAN	Y		N	Y						R	Y					N	5
ARASU	55 M	N	N	CKD	CABG	DR MANIKANDAN	Y		N			Y					Y					N	4
THANGARAI	55 M	N	N	MR	MVR	DR MUTHU	Y		N					Y		R	Y					N	3
SARADAMOTHY	47 F	N	N	RHD/MS	MVR	DR GANESAN	Y		N					N						Y		N	5
REKHA	22 F	N	N	RHD/MS	MVR	DR SIVARAJ	Y		N			N					Y					N	5
RAJALAKSHMI	20 F	N	N	ASD	ICR	DR SIVASUBRAMANI	Y		N	N							Y					N	3
RAMACHANDRAN	37 M	N	N	ASD	ICR	DR SIVASUBRAMANI	Y		N			N					Y					N	3
PRABU	40 M	Y	N	AR/MR	DVR	DR SIVARAJ	Y		N					N						Y		N	3
MUNUSAMY	52 M	Y	N	AS	AVR	DR MARIAPPAN	Y		N			N					Y					N	4
NARAYANAN	47 M	N	N	CKD	CABG	DR MANIKANDAN	Y		N	N							Y					PAIN	4
DEVANAI	38 F	N	N	ASD	ICR	DR MANIKANDAN	Y		N			Y				R	Y					PAIN	4
RATHINAM	57 M	N	N	CKD	CABG	DR MARIAPPAN	Y		N					N			Y					N	5