

USE OF MECHANICAL SUTURES IN PULMONARY SURGERY

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ABSTRACT

In a ten years period, Six hundred and twenty patients underwent surgical treatment for different kinds of pulmonary diseases. Pulmonary tuberculosis was the indication for 395 thoracotomies and 115 patients were operated for lung cancer. Ninetyone thoracotomies were performed for chronic non-specific diseases of the lung and in 19 cases indications for pulmonary resection were other diseases. In all cases various types of mechanical staplers were used for individual suturing of the pulmonary vessels and bronchus. Operations performed included 207 pneumonectomies, 341 lob and bilobectomies, 49 segmentectomies and 23 combined resections. Chronometry was done in seventyone thoracotomies with average time spent for each operation being one hour and fortyseven minutes only. Out of this time, only four minutes and thirtyfour seconds (4.2%) were spent for individual suturing of the pulmonary vessels and bronchus. During the operation insufficiency of mechanical sutures were seen in few cases and dealt with accordingly. Arterial and bronchial stump insufficiency were noted in three percent cases each, whereas venous suture insufficiency was seen only in 1.3 percent cases. Five hundred and fortysix patients (88.1%) had a benign

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course, whereas fortythree patients (6.9%) experienced postoperative complications. But only in sixteen cases (2.6%) could the mechanical sutures be related theoretically for those complications. There were thirtyone hospital deaths (5%). Our results show that the use of mechanical sutures is safe, considerably reduces the time for pulmonary resection and is associated with relatively very few intraoperative and postoperative complications.

INTRODUCTION

Postoperative complications, especially bronchopleural fistulae constitute a major therapeutic challenge for the thoracic surgeon. Although the incidence of postresection bronchopleural fistula has reduced in recent years, it remains a constant and dangerous complication of pulmonary surgery that is why thoracic surgeons all over the world have been searching a new method of bronchial stump closure which could give better result after pulmonary resection. Many thoracic surgeons have experiences of postoperative mortality among patients due to slipping of the ligature from the pulmonary vessels. The new Soviet made auto-suture clamps are very secure devices for suturing of the pulmonary vessels and bronchial stump. Here we report our results in 620 patients who were operated with the use of these devices.

MATERIALS AND METHODS

During the years 1965, to 1975, Six hundred and twenty thoracotomies were performed in six hundred and twenty patients at the Department of Thoracic Surgery of Leningrad Scientific Research Institute of Pulmonary Tuberculosis headed by Prof. Y. M. Repin. In all cases different types of Soviet made auto-suture clamps were used for individual suturing of the pulmonary vessels and closure of the bronchial stump. The group included 461 men (74.4%) and 159 women (25.6%). Age distribution is shown in Table 1. Tuberculosis was the indication for 395 operations (63.7%). One hundred fifteen patients (18.5%) were operated for cancer. In ninetyone cases (14.7%) the causes of thoracotomy was chronic non-specific pulmonary disease and in the remaining nineteen patients (3.1%) the operative procedure was performed for other diseases. Pulmonary resection was accomplished in all cases. The operative procedures are listed in Table 2.

TABLE 1

Age distribution of 620 patients

Age (years)	No. of patients	Percentage
Under 18	39	6.3
18 - 29	142	22.9
30 - 49	356	57.4
50 and over	83	13.4
TOTAL	620	100.0

TABLE 2

Pulmonary resection in 620 cases

Procedure	INDICATION FOR OPERATION				Total no. of pts.	%
	Tuberculosis	Cancer	Chronic non specific diseases	Other diseases		
Pneumectomy	107	77	23	-	207	33.4
Bilobectomy	18	1	6	-	25	4.0
Lobectomy	211	36	52	17	316	51.0
Segmentectomy	42	-	5	2	49	7.9
Combined resection	17	1	5	-	23	3.7
TOTAL	396	115	91	19	620	100.0

OPERATION

A posterolateral or anterolateral thoracotomy was utilized in almost all cases. Usually rib resection was not performed for exploration. In all cases dissection of the lung from adhesions was performed compulsorily. The type of resection used was based on intraoperative findings. Pulmonary vessels and bronchus of the resected part of the lung were dissected one by one. The bronchus was mobilized with a minimum of dissection to prevent devascularization. After this usually proximally and distally of each element of the hilum of the resected part of lung mechanical sutures are applied by means of different types of auto-suture clamps. The size of the device depends on the diameter of the blood vessels and bronchus. Thus, pulmonary artery and veins for pneumonectomy are sutured by US-30, US-20 and UKSN-25 auto-suture clamps, whereas devices like US-20, UAP-20 and US-10 are used for this purpose in lobectomy and segmental resection. For the closure of the bronchial stump in pneumonectomy devices like UKL-60, UKL-40 and UKB-25 are used whereas lobular and segmental bronchi are closed by UKL-40, UKB-16, US-30 and UAP-25. In nine operations in which there was no possibility to dissect the hilum of the resected part of the lung UKL-60 was applied enmasse to suture it. The auto-suture clamp is applied as close to the origin of the bronchus and vessels as possible. These devices insert a staggered double row of titanium clips, with a space of 1mm between the rows. The design of the anvil of the clamps is such that the staples are closed in a figure 'B' and are not flat. The vessels and bronchus are then divided. The bronchial stump is not protected with either a pleural flap or muscle pedicle graft. The chest is closed in layers with two intercostal drainage tubes for partial resections and with one for pneumonectomy. Postoperative treatment is given according to the disease and magnitude of the operation.

TABLE 3

*Average time spent for suturing of the pulmonary vessels and bronchus in 71 cases

Element of the hilum of the lobe or luh	Average time for suturing	Percent of the average operation
Artery	1 min 45 sec	1.6
Vein	1 min 40 sec	1.5
Bronchus	1 min 9 sec	1.1
TOTAL	4 min 34 sec	4.2

* Average time for one pulmonary resection was 1 hour 47 min.

TABLE 4

Incidence of post-operative complications in 620 patients undergoing pulmonary resection

Procedure	C o m p l i c a t i o n s					Death	TOTAL
	None	Hemothorax	Primary bronchial fistula	Empyema secondary bronch. fist.	Empyema		
Pneumonectomy	166	4	1	13	3	20	207
Lob- & bilobectomy	317	9	-	5	3	7	341
Segmentectomy	43	2	-	2	-	2	49
Combined Resection	20	-	-	1	-	2	23
TOTAL	546	15	1	21	6	31	622

In 71 different pulmonary resection we measured average time spent for each operation, which was just one hour and fortyseven minutes. During this procedure average time spent for suturing of the pulmonary vessels and bronchus is also measured (Table 3).

RESULTS

During the operation slight oozing from the sutured part of arteries were seen in nineteen cases (3%). Out of 359 suturing of the arteries by UAP type clamps oozing was seen in twelve cases ($3.3 \pm 1.03\%$), whereas the suturing defect of the US (UKS) type clamp was noted in seven operations out of 242 suturings ($2.8 \pm 1.09\%$). Slight oozing from the sutured part of the pulmonary veins were noted in eight cases (1.3%). 418 applications of UAP type clamp this minor complication was seen only in two cases ($0.5 \pm 0.3\%$), whereas after 306 uses of US type clamp it was seen only in two cases ($1.9 \pm 0.8\%$). After the closure of the bronchial stump by means of UKL devices suture insufficiency was noted in nine out of 300 uses ($3.0 \pm 0.98\%$). The same number of bronchial stump insufficiency was seen after 226 uses of UKB clamp ($4.0 \pm 1.3\%$) and only in one case this defect was seen after 116 uses of UAP and US type clamps for bronchial stump closure in lobectomy and segmentectomy. As a whole, total number of insufficiency after bronchial stump closure was noted in 19 cases out of 620 (3.0%).

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An uneventful hospital course occurred in 546 patients (88.1%) whereas 43 patient (6.9%) experienced postoperative complications. But only in 16 cases (2.6%) mechanical sutures could be related theoretically for these complications. There were 31 hospital deaths (5%).

Detailed analysis of the postoperative complications in 620 patients undergoing pulmonary resection is presented in Table 4. Complications which could be related as consequences of the use of auto-suture clamps were quite few. Among them fifteen patients experienced hemothorax (2.4%) and only one (0.16%) had primary bronchial fistula. But further analysis proved that these complications had no relation with the used technique of vascular and bronchial closure. For example all cases of hemothorax were due to oozing from the tissues of the mediastinum and chest wall. This was proved in three cases of rethoracotomy for bleeding into the pleural cavity. In twelve other cases hemothorax was limited and thus did not necessitate reoperation. One patient experienced primary bronchial fistula after right sided pneumonectomy for advanced tuberculosis. It happened on the second postoperative day. Rethoracotomy was performed immediately with the closure of the bronchus with nylon sutures. But the patient died on the 20th postoperative day due to empyema leading to secondary bronchial fistula and aspiration pneumonia of the remaining left lung. Autopsy revealed generalised tuberculous process in other internal organs as well. Gross inflammatory changes of tuberculosis were found in the bronchial wall.

Empyema of the pleural cavity leading to secondary bronchial fistula were diagnosed in twentyone cases (2.4%). Majority of them were operated for pulmonary tuberculosis. Cause of empyema in these cases were accidental contamination of the pleural space due to spillage of secretions from the pulmonary cavities during resection. Empyema without secondary bronchial fistula was seen in six cases (0.9%). Cause of this complication was the same as for the patients suffering from secondary fistula.

Thirtyone out of 620 patients (5%) died during the post-operative period. Operative mortality was high among patients undergoing pneumonectomy (9.6%). In this group majority of the patients died due to circulatory failure and various other complications rather than pleuropulmonary complications itself. Chest infection was cause of death in three cases, whereas one patient died of aspiration pneumonia. Among 413 patients undergoing different types of pulmonary resection five died of pleuropulmonary complications and six due to other causes. Table 5 shows causes of operative mortality among our patients.

TABLE 5

Causes of operative mortality

Procedure	Causes of operative mortality					TOTAL
	Bleeding into the empyema cavity	Aspiration pneumonia	Chest infection	Circulatory failure	Others	
Pneumonectomy	-	1	3	11	5	20
Lob- & bilobectomy	-	-	2	4	1	7
Segmentectomy	1	-	-	1	-	2
Combined Resection	1	-	1	-	-	2
TOTAL	2	1	6	16	6	31

DISCUSSION

Bleeding from the stump of pulmonary vessels is a very dangerous complication. Many surgeons have experienced this fatal complication. 1-3 But in our series there was no such incidence, whereas among 1114 pulmonary resections performed in our hospital during the same period in which thread was used for ligation of the blood vessels, two patients died of bleeding from the arterial stump. The cause of profuse bleeding in these was slipping of the ligature. Primary bronchial fistula is also a known complication after pulmonary resection. They are seen in upto 5 percent cases 4-6. In our series there was only one case with this complication. It was due to generalized tuberculosis affecting the bronchial wall besides other organs.

Hemothorax is quite a frequent complication after pulmonary resection 6-10. It is seen in upto 10 percent cases undergoing lung resection, but in our series, this complication was seen only in 2.5 percent cases. Established cause of hemothorax was oozing from the mediastinum and chest wall, but not the sutured pulmonary vessels. Bronchial fistula followed by empyema thoracis is a serious, sometimes fatal complication which, usually follows pulmonary resection. The incidence of this complication differs among the work of different authors from 2 to 20 percent 11-18. Though it occurs with all types of bronchial closure,

incidence after the use of mechanical suture is very low 19-22. These are quite efficient and very convenient for use. Although bronchopleural fistula is most commonly associated with tuberculosis, it also occurs in association with pulmonary resection for cancer and inflammatory disorders. In our series majority of the secondary bronchial fistula was associated with tuberculosis. The etiology of the bronchial fistula is complex. Bjorn (1956) 23 stated that infection was virtually the only cause of bronchial fistula formation. However, it is now proved that many factors contribute to its formation. Devitalization of the bronchial stump is undoubtedly an important factor. The end of the bronchus should heal and if this is deprived of an adequate blood supply, necrosis is inevitable. Infection still plays an important role in fistula formation. The source of infection is usually accidental contamination of the pleural space from spillage of secretions from the pulmonary cavities during resection. By far the most important role is played by suture material and mechanical suture is undoubtedly the best 24-25.

CONCLUSION

Thus by using mechanical suture devices pulmonary resection can be performed quickly and safely. Intraoperative complications are not dangerous and minor. Incidence of postoperative complications like hemothorax and bronchial fistula are minimum.

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