

Functional Evaluation in Accordance with Reconstructive Method of Tracheobronchial Tree

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Received for publication, March 25, 1982

The operative methods available for the tracheobronchial reconstruction were experimentally evaluated.

Patch closure as a reconstructive procedure is useful for a repair of the limited lesions on the wall of the trachea and the bronchus. The pericardium used for patch material prompted the histologically excellent healing process. We have just become aware of the limitation of the resected extent for its use. Its limitation in length is within 1.5 times the tracheal or bronchial circumference in prevention from the patch collapse.

Wedge resection method is also beneficial in performing the repair for a localized lesion. The indication for the diseased extent is limited to 1.5 times the diameter of the reconstructed bronchus or trachea.

The end to end anastomosis as the operative technique of the tracheobronchial reconstruction is exclusively recommendable, whenever the sizes of anastomosed orifices are different to some extent.

The end to side anastomosis also should be feasible as the operative technique routinely used. It is worthwhile to note from this study that an oblique anastomosis method in sleeve-fashioned reconstruction is functionally superior to the right angle one.

INTRODUCTION

It is widely accepted that operative management for tracheobronchial lesions is indispensable to either relief of respiratory distress or control of repeated infectious attack. On the other hand, many surgeons have a reluctance to extend its indication because it

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offers pessimistic outcome directly related to an inherent operative techniques on occasion.

It is considered indicative for treatment of the lesion of stenosis caused by scar formation and benign or malignant tumors but there are some problems in prevailing the safe application. As for the operative techniques, large research work has been accumulated during the past two decades. A great disadvantage of using this techniques are likely to be a limitation of the resected extent to accomplish an excellent reconstructive procedure for the subsequent defect of the tracheobronchial trees to resect. On the other hand, one should take into consideration as to how well and how long the reconstructed air way will function.

The ultimate purpose of this study is to experimentally establish an ideal operative procedures of the tracheobronchial reconstruction that will be potentially applicable in human being.

MATERIALS AND MDTHODS

Mongrel dogs were subjected in this study, ranging in body weight from 15kg to 20kg. They were randomly assigned to one of the varying reconstructive procedures. As the reconstructive methods for the tracheobronchial tree, the advantages and faults mainly attributed to inherent operative techniques were evaluated among experimentally designed operative methods, that is, patch method, direct suturing after wedge resection, an end to end or end to side anastomosis. A total of 32 dogs were assigned to four different procedures. An end to side anastomosis between the trachea and the bronchus was performed in the two different ways. One was directly anastomosed, creating the window defect on the tracheal wall, the other was obliquely anastomosed in a similar manner except for cutting the bronchial stump obliquely.

RESULT

As for the patch method with the pericardial graft, an excellent healing process was histologically observed with the elapse of time. As shown in Fig 1. the pericardial patch itself was replaced with fibrocollagen tissue, allowing the regenerated mucosal layer without any of the foreign body reactions. This process was completed at least one month after surgery. As a result of functional evaluation, a wide defect in the tracheal wall enabled the patch graft to collapse in expiration and to protrude in inspiration according to the respiratory cycle as shown in Fig 2. When a transectional defect of the trachea exceeds half the tracheal circumference, this procedure should not be indicated for the means of surgical repair. However, it is no doubt that the limited defect of the trachea should be a better candidate for the use of this technique.

As for the wedge resection of the tracheal wall, its use hae has limit of the resected extent. While longitudinally resected length on the tracheal wall will be over 2 times the tracheal diameter, the reconstructed trachea makes angulation accompanying the pouch

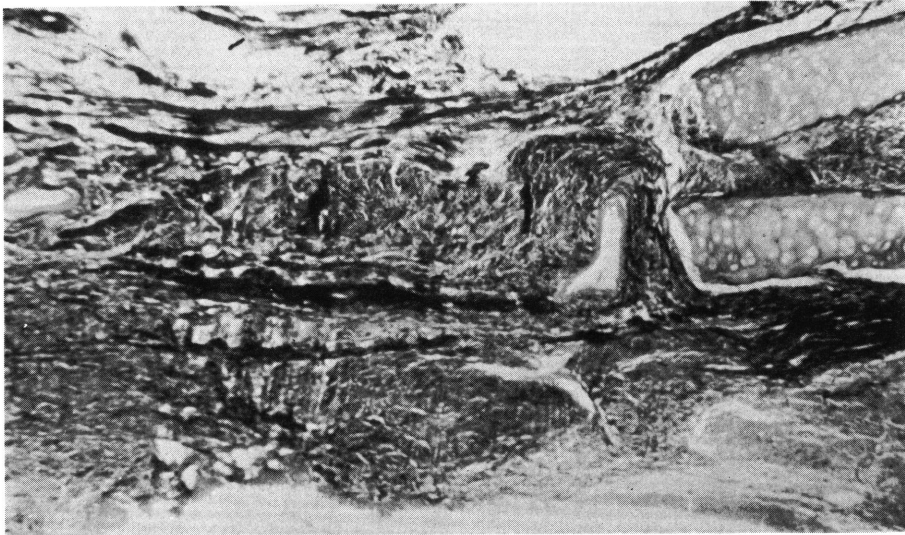


Fig 1. An example of histologically healing process in pericardial patch graft.

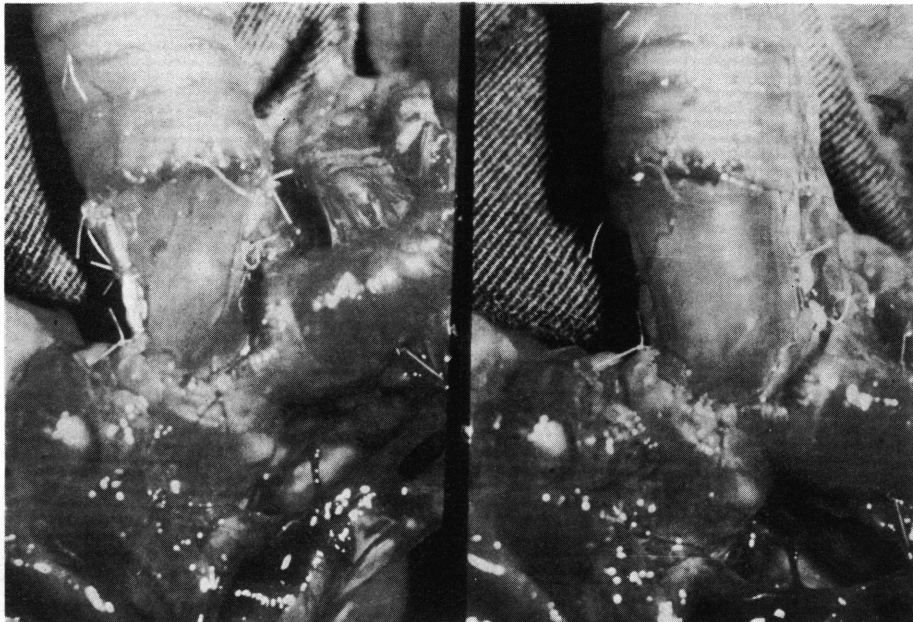


Fig 2. Paradoxical movement of pericardial patch graft according to respiratory cycle, left: collapsed pericardial graft in expiration, right: protuded one in inspiration.

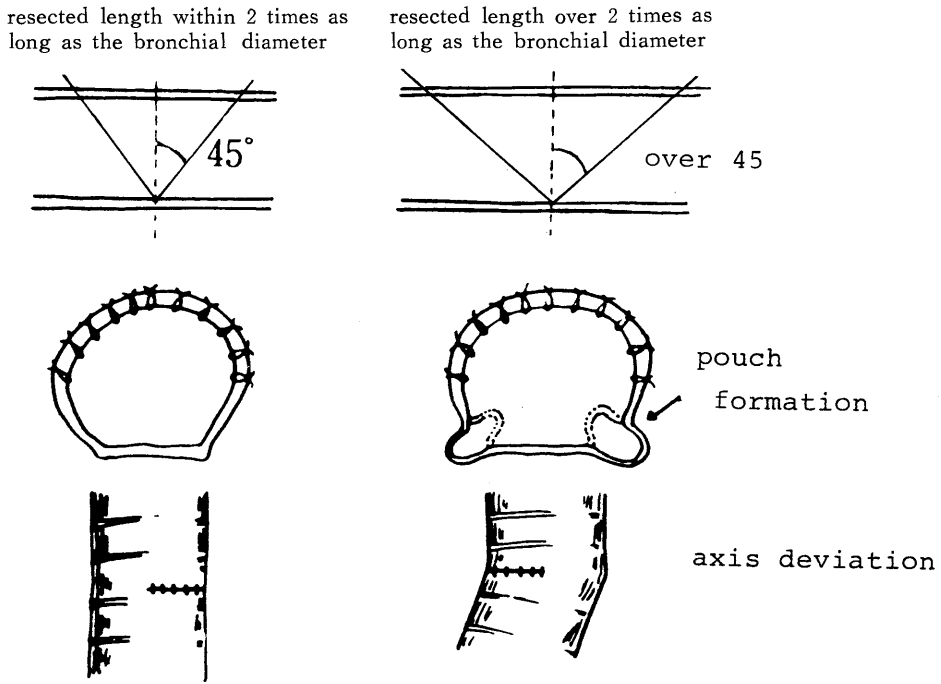


Fig 3. Diagram showing a reconstructed trachea following wedge resection. Left: when length of resected extent is within 1.5 times the tracheal diameter, tracheal reconstruction is satisfactory, right: if it exceeds 1.5 times in length, its outcome is unsatisfactory because of blind pouch formation and axis deviation.

produced on both edges of suturing line as presented in Fig 3. Wedge resection is favorably feasible when the resected area in length is within 2 times the tracheal diameter.

Furthermore, an operative techniques of either the end to end or the end to side anastomosis were functionally evaluated. The end to end anastomosis as an operative procedure of tracheobronchial reconstruction is best to give a satisfactory result. When the diameters of the tracheobronchial stumps anastomosed are different in sizes, the obliquely cutting or V shape cutting for the small sized trachea are beneficial in giving an proper adaptation in size at anastomotic site as shown in Fig 4.

When performed the end to side anastomosis between the trachea and the bronchus, the attitudes of air flow into

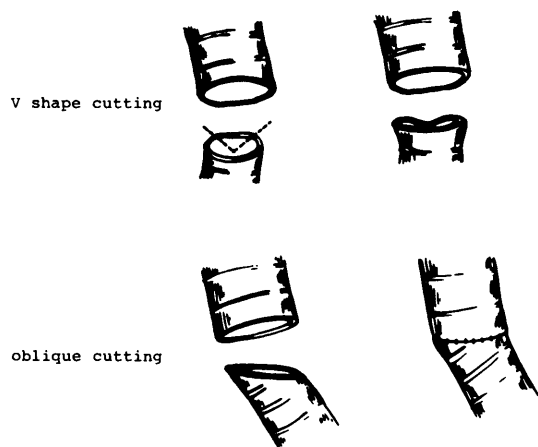


Fig 4. Diagram showing methods of making the different size of anastomosed lumens adaptable, upper: V shape cutting in the smaller sized trachea or bronchus, lower: oblique cutting.

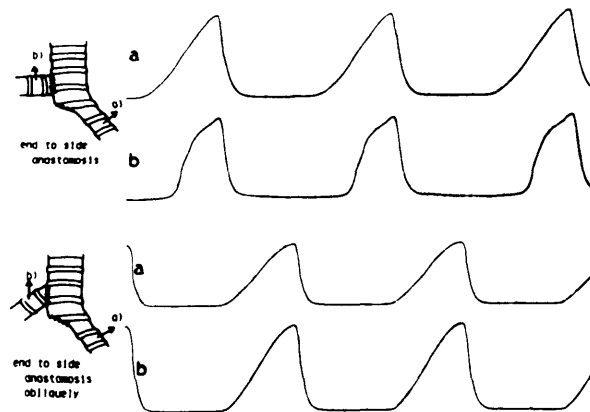


Fig 5. Comparison of patterns of pressure curve at the end to side anastomosis between right angle and oblique anastomosis. a: pressure curve in contralateral intact bronchus, b: pressure curve in reconstructed bronchus.

the reconstructed bronchus were observed with the use of intraluminal pressure tracing. The comparative study was made of pressure tracing between the reconstructed bronchus and contralateral intact one as well as between the directly and obliquely anastomosed bronchus. As delineated in Fig 5, the oblique anastomosis produced a favorable pressure curve, reflecting a less degree of air way resistance. It showed no significant differences between those of reconstructed and contralateral intact bronchus. On the other hand, the directly anastomosed bronchus with right angle to the trachea yielded the time-elongation of the ascending limbs on pressure tracing curves, reflecting somewhat increasing air way resistance.

As a result of intraluminal pressure tracing study, it is certain that the oblique anastomosis between the bronchus and the trachea should provide functionally better results.

DISCUSSION

The tracheobronchial reconstructive surgery is essential in relieving a respiratory distress syndrome which is mainly caused by benign or malignant tumor as well as the resulting cicatric stenosis from a presence of imposed infection or trauma^{1)~5)}. A widened resection is not necessarily required if the lesion are limited in location. In such a situation, wedge resection is available for surgical management.

As a result of this study, care must be taken to avoid performing a wide wedge resection which may contribute to functional impairment, due largely in part to the ensuing angulation on the reconstructed tracheobronchial tree. It should be noted that the resected extent by wedge method should be within 2 times the diameter of the re-

sected trachea or bronchus. It is no doubt that the most favorable method for performing reconstruction of the tracheobronchial tree is an end to end anastomosis. It is feasible with an aid of procedures of oblique or V shape cutting to the smaller bronchus whenever the anastomosed trachea or bronchus may be not equal in sizes of their lumens each other.

Of the lesions located on the wall of the main bronchus close to the bifurcation, the end to side anastomosis is potentially useful for performing the reconstruction of the tracheobronchial tree. When only the longitudinal incision on the tracheal wall will be performed, alteration in size of the anastomosed area on the tracheal wall is apparent according to respiratory cycle, in particular, it becomes much smaller in expiratory phase.

It is necessary to create the window defect on the tracheal wall corresponding to the true size of an anastomosed bronchus.

With the use of this procedure, an appropriate anastomosis between the trachea and the bronchus may be ensured. In this report, comparative study between an oblique and right angle anastomosis was made to elucidate as to which methods will function better. On the basis of the results of intrabronchial pressure tracing study, the procedure of oblique anastomosis of the bronchus to the trachea affords a great advantage of lowering the air way resistance. It seems reasonable to recommend the oblique anastomosis when sleeve anastomosis between the trachea and the bronchus are attempted.

REFERENCES

- 1) SATO, R., et al: Stricture of thoracic trachea following closed chest injuries, report
- 2) FRAETER, R, W, M and KAPLAN, B, Bilateral bronchostenosis: successful surgical repair at one operation, *Surgery* 55: 407, 1964
- 3) BOYD, A.D., SPENCER, F, C and LINDN. A.: Why has bronchial resection and anastomosis been reported infrequently for treatment of bronchial adenoma? *J. Thorac. Cardiovasc. Surg.*, 59:359,1970
- 4) PAUISON, D.L and CHAW, R.R.: Results of bronchoplastic procedures for bronchogenic carcinoma, *Ann, Surg.*, 151:729,1960
- 5) JENSIK, R.J., FABER, L.P., MILLOY, F.J and GOLDIN, M.D : Tracheal sleeve pneumonectomy for advanced carcinoma of the lung, *Surg. Gynecol Obsect.*, 134; 231, 1972