Mark IV Repair of Hiatal Hernia by the Transthoracic Approach

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Following 10 years of clinical evaluation of various surgical techniques for control of gastroesophageal reflux, the Mark IV repair was developed and has now been used in over 2,000 patients. The operation is performed through a left posterolateral thoracotomy and entails extensive mobilization of the esophagus up to the aortic arch with preservation of the vagus nerves, and a 240 degree semi-fundoplication between the stomach and esophagus. The lower esophagus and its sphincter are returned to the abdomen when possible, and the two halves of the right crus of the diaphragm are gently approximated to create a posterior buttress. When indicated, surgical treatment of associated upper abdominal disorders can be accomplished through the thoracic approach. A review of 892 patients who had undergone Mark IV repair during a 10-year period showed that 84% had an excellent or good result with an 86% follow-up rate. The over-all recurrence rate was 11%, with indications that a significant number of failures were due to deviations from the standard Mark IV technique. Surgical treatment of recurrent hiatal hernia by the Mark IV technique is technically difficult. Of the 892 patients reviewed in 1972, the late results in 98 were classified as unsatisfactory. Of these, 45 required further surgical treatment which consisted of a second Mark IV repair, resection of the cardia and reconstruction, or gastric resection. The late results of reoperation were excellent or good in 75% of patients. Dilatable strictures may be treated by the Mark IV repair, but there is only a 50% chance of success. Undilatable strictures require resection followed by interposition of left colon or jejunum. Prevention of stricture by recognition and treatment of reflux esophagitis is the best management.

During the 10-year period 1942-1952 various surgical techniques for the control of gastroesophageal reflux were subjected to clinical trial in the Regional Thoracic Surgery Unit at Frenchay Hospital, Bristol. Throughout this trial the objective was the restoration of a competent valvular mechanism at the cardia rather than the reduction of an internal hernia; in short, a physiological rather than anatomical solution. It became apparent that anatomical reduction of a hiatal hernia did not necessarily control reflux through an incompetent lower esophageal sphincter. The results of these trials were assessed by regular clinical, radiological, and occasionally endoscopic examinations in the follow-up clinic. The criteria adopted were those outlined in the introduction to this symposium. The technical principles evaluated were:

1. The reestablishment of an acute esophagogastric angle at the cardia.
2. The shortening and strengthening of the "crural sling" with its assumed pinchcock action as advocated by Allison [1].
3. The restoration of the lower esophageal sphincter (LES) to the high pressure zone below the diaphragm.

By 1952 it was evident that the principle of restoring the L.E.S., together with 4 of 5 cm of lower esophagus (owing to the difficulty of delineating the anatomical limits of the sphincter zone) to the high pressure region proved more successful in satisfying the 4 basic criteria than the alternative principles, and the technique designated as the Mark IV repair was evolved. This terminology was adopted to emphasize that previous techniques had been subjected to clinical trial and abandoned on evidence accumulated in the follow-up clinic. The essential principle differs from that underlying other surgical techniques currently practiced in the control of reflux. It should be stressed that evolution occurred on the basis of the time-honored principle of clinical trial and error and the observed long-term results. Over 2,000 patients have now been treated by this technique for reflux resistant to medical treatment [2-7]. Only minor modifications have proved necessary and these will be described.
Technique of the Mark IV Repair

The advantages of the thoracic approach are as follows:

1. The single most important step in the Mark IV Repair is adequate mobilization of the esophagus up to the aortic arch to enable the lower sphincter zone to be positioned in the high pressure region. This can be achieved without tension only by the thoracic route.

2. In the case of the recurrent hernia, mobilization of the cardia in the presence of the postoperative adhesions resulting from previously attempted repairs may prove hazardous or technically difficult by the abdominal approach.

3. The improved exposure reduces the risk of vagal damage during mobilization.

4. Access to the upper abdomen, the gall bladder, bile ducts, stomach, duodenum, and pancreas is adequate for the synchronous surgical treatment of coincidental pathology.

5. Synchronous one-stage resection and reconstruction of the lower esophagus is facilitated when the secondary shortening and fibrosis resulting from chronic esophagitis is found at operation to render any repair without tension impossible. Alternatively, the Pearson procedure may be undertaken if fibrosis is not too extensive [8].

6. Post-thoracotomy pain, the main disadvantage of the thoracic approach, can be reduced or prevented by certain technical maneuvers to be described.

7. The late postoperative results of the Mark IV Repair, 5 years or longer after operation, have been recorded in a statistically significant series of patients.

Exposure

The stages of the operation have been adequately illustrated in a recent publication [2] and only those technical details or modifications considered to have contributed to progress will be discussed herewith.

An oblique left posterolateral thoracotomy over and parallel to the sixth interspace, from the lateral border of the erector spinae muscle down to the costal margin will afford excellent exposure. The pleural cavity is entered above the upper border of the seventh rib. One centimeter is resected from the posterior end of the seventh rib beneath the erector spinae, and the seventh intercostal bundle is ligated and divided before the rib spreaders are inserted. The sixth and seventh ribs are distracted to the minimum degree necessary for the repair. If desired, the exposure can be improved by division of the costal margin at the anterior end of the sixth interspace or by dividing the posterior end of the sixth rib and bundle, rather than by the more aggressive use of the rib spreaders. The higher the thoracotomy, the less the postoperative discomfort; the incision most commonly followed by intractable pain is the thoracotomy through the eighth or ninth interspace. A further advantage of the sixth interspace incision is the exposure afforded when resection of a stricture and synchronous reconstruction prove to be necessary.

In 15% of cases of reflux other upper abdominal pathology is present, such as chronic cholecystitis, cholelithiasis, peptic ulceration of stomach or duodenum, or pyloric obstruction. Ideally any additional surgery indicated should be performed at the same operation and through the single incision if technically feasible. Adequate access to the upper abdomen is readily obtained if the chest has been entered through the sixth interspace. The incision is extended downwards to the lateral border of the rectus sheath and the cartilaginous costal margin is divided. The diaphragm is then divided circumferentially from the costal origin, from the cardiophrenic angle anteriorly for a distance of 15 cm posteriorly, leaving a 1 cm fringe on the chest wall to which the diaphragm is resutured during closure. The phrenic nerve supply to the diaphragm is preserved intact. The oblique muscles of the abdominal wall are divided in the line of the incision down to the rectus sheath, thus creating a T-shaped incision into the peritoneal cavity. Upward retraction of the diaphragm facilitates any additional surgery indicated, including cholecystectomy and exploration of the common bile duct. During closure of the thoracotomy the diaphragm is resutured at the fringe on the chest wall, with its function unimpaired. There has been no case of postoperative dehiscence or herniation through the diaphragmatic incision following this technique for gaining access to the abdomen. The synchronous correction of the reflux and any complicating abdominal pathology at a single intervention is more advantageous to the patient than any multistage program.

The thoracotomy technique has been described in detail owing to the overriding importance of adequate exposure in the conduct of a satisfactory anti-reflux procedure and the avoidance of subsequent chest wall discomfort.

Mobilization of the Esophagus and Cardia

Extensive mobilization of the lower esophagus, with preservation of the vagus nerves, is the essential step in the Mark IV procedure. The mobilization is extended upwards to the point where the vagi pass from the lung hila to the esophagus. This dissection involves division of the important unnamed artery running from the descending aorta to the junction of the middle and lower thirds of the organ, and the in-