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HERNIATION OF THE HEART AFTER INTRAPERICARDIAL PNEUMONECTOMY FOR BRONCHIAL CARCINOMA

BY

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Since the pioneer work of Graham and Singer (1933), Rienhoff (1933), and Crafoord (1938), great improvements have been made in the surgical technique for resection of bronchial carcinoma. Of major importance was the introduction by Allison (1946) of intrapericardial ligation of the pulmonary vessels. Besides inherent advantages due to the intrapericardial disposition of these vessels and consequent ease of dissection (Healey and Gibbon, 1950), the procedure allows a more radical excision of malignant tissue. It does not lead to cardiac incapacity, and the vessel walls inside the pericardium are muscular and tolerate ligation well (Bailey, Tropea, and Rubenstein, 1947). A lower mortality and longer time of survival have been reported when this procedure is used as a routine in radical pneumonectomy compared with extrapericardial simple pneumonectomy (Brock and Whytehead, 1955).

Among the complications especially attributable to an intrapericardial pneumonectomy are cardiac arrhythmias and herniation of the heart (Bettman and Tannenbaum, 1948; Higginson, 1953). Two cases of herniation of the heart have been encountered during recent months at the North Middlesex Hospital and are reported here.

CASE REPORTS

CASE 1.—A man aged 66 years underwent a left intrapericardial pneumonectomy (R. L. H.) for a bronchial carcinoma of the left upper lobe on August 13, 1957. The pericardial opening was oval in shape, measuring 3 in. by $2\frac{1}{2}$ in., and extended from the upper margin of the pulmonary artery to the lower margin of the inferior pulmonary vein. No attempt was made to close the pericardial defect. The chest was closed and the patient turned on to his back and bronchoscoped. The underwater drainage tube was clamped and the nurses were instructed to release the tube for one minute each hour post-operatively. He was then transferred to his bed in a right semilateral position maintained with pillows under the back. (This post-operative positioning has been our routine practice in all cases of intrapericardial pneumonectomy.) While recovering consciousness in the theatre the patient became restless, gradually pronounced. In addition severe precordial pain developed. The pulse and blood pressure were within normal limits. After transfer to the ward an intravenous injection of 50 mg. pethidine was given. Thirty minutes later restlessness was still marked and morphia, gr. 1/6, was given intravenously. The morphia had to be repeated after four hours because of persistent chest pain and restlessness. There was no cyanosis, the trachea was central, and the air entry into the right lung was normal. The heart sounds were replaced by a loud churning sound of fluid and air, as often occurs after an intrapericardial resection. About eight hours after operation the patient suddenly became shocked and drowsy; the pulse was thready and the blood pressure 40 mm. Hg. The drainage tube was unclamped, but there was no evidence of intrapleural haemorrhage to account for the shock. The air entry into the right lung was normal. One pint of blood was administered rapidly, but this did not improve the patient's condition. There was slight venous congestion of the neck veins. A noradrenaline drip raised the blood pressure to 120/70 mm. Hg, but the blood pressure fluctuated considerably and was unstable. A chest radiograph (Fig. 1) revealed what was thought to be a marked displacement of the mediastinum to the left. Adjustment of the intrathoracic pressures with a pneumothorax apparatus did not improve the patient's condition, and despite the further administration of noradrenaline he died in shock 30 hours after the operation.

At necropsy the heart was seen to have herniated from the pericardium into the left hemithorax. The opening in the pericardium had stretched to at least twice its previous size and had retracted behind the heart. The right auricle was distended. There was no evidence of coronary thrombosis. There was acute congestion of the upper part of the right lobe of the liver.

The ante-mortem congestion of the neck veins and the acutely congested liver seen at necropsy were suggestive of compression or twisting of

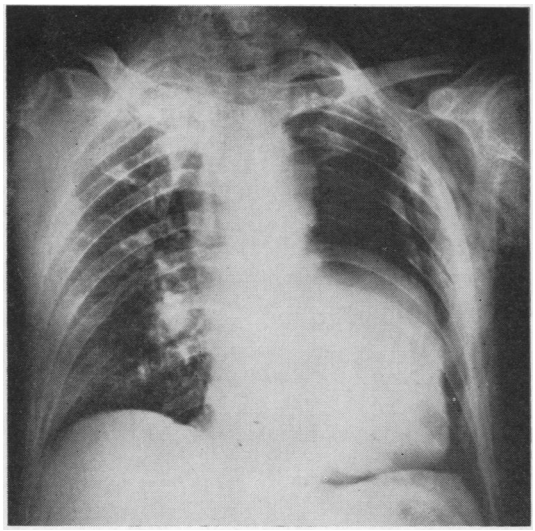

FIG. 1

both venae cavae. An immediate thoracotomy with incision of the pericardium right down to the diaphragm would probably have relieved the vena caval obstruction and might have saved the patient's life.

CASE 2.—A healthy but heavily built man, aged 31 years, underwent a left intrapericardial pneumonectomy (M. B.) for a bronchial carcinoma on January 30, 1958. The vessels were divided within the pericardium and the resulting pericardial defect extended in its lower part to a point mid-way between the left inferior vein and the diaphragm. At the time of operation it was remarked that the heart might herniate through this defect, but pericardial closure was not attempted as the defect was too large to be closed without causing cardiac tamponade. The chest was closed and underwater drainage instituted. The patient was transferred to his bed, and laid in a right semi-lateral position maintained with pillows. While recovering from the anaesthetic he became very restless and the clinical condition closely resembled that of Case 1. The pulse and blood pressure were within normal limits. The chest pain was not relieved by morphia, gr. 1/6 intravenously, which had to be repeated on transfer to the ward. The patient slept comfortably for four hours and then became as restless as before. There was no congestion of the neck veins, the air entry into the right lung was normal, and the trachea was central. The heart sounds over the precordium were completely replaced by splashing sounds of air and fluid which could be heard at the patient's bedside without a stethoscope. A chest radiograph (Fig. 2) showed appearances identical with those of Case 1, and there was therefore no hesitation in diagnosing cardiac herniation. It was decided to perform an immediate thoracotomy. While the patient waited to go to the theatre the pulse gradually rose to 140, but the blood pressure remained steady at 130–140 mm. Hg systolic.

On re-opening the chest it was seen that the pericardium had retracted behind the heart, which was beating vigorously. The surface of the heart was roughened and the coronary arteries were covered with very oedematous fat. The roughening of the cardiac surface was especially marked over its area of contact with the chest wall in the left paravertebral gutter. The retracted pericardium was incised down to the diaphragm so as to open it as widely as possible. A continuous electrocardiogram showed no change at any stage of the operation. The chest was closed without drainage and 10 oz. saline left in the pleural cavity. The patient was removed from the operating table in the right lateral position.

During the night little sedation was required, and apart from a slight tachycardia the clinical condition remained excellent. In the afternoon of the next day, the patient suddenly became cyanotic and breathless and a chest radiograph showed that the heart was displaced into the left hemithorax. His condition rapidly deteriorated and he died in a state of shock and pulmonary oedema 31 hours after the initial pneumonectomy.

At necropsy the heart was lying in the left chest with its long axis more horizontal than is normally the case. It was slightly dilated. The visceral pericardium was roughened over its area of contact with the chest wall. There was no congestion of the liver.

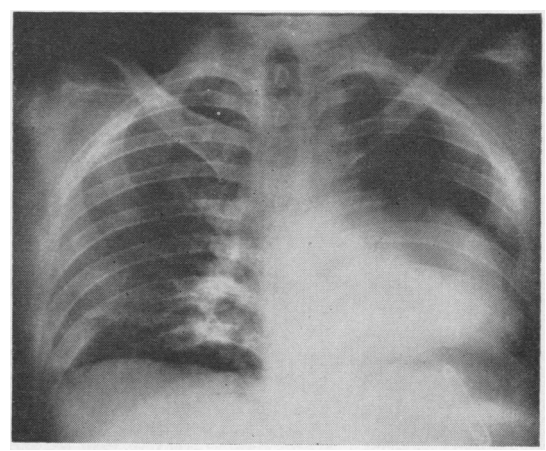

FIG. 2

In this case the blood pressure remained at a normal level despite the cardiac displacement. Tachycardia and chest pain occurred as a result of the heart being displaced. There was no electrocardiographic evidence of myocardial ischaemia. It was felt that if the heart had

remained in its normal anatomical position after the second operation the patient might have survived.

Discussion

The indications for, and the advantages of, an intrapericardial pneumonectomy have been universally accepted. Bettman and Tannenbaum (1948) emphasized the danger of too small an opening in the pericardium in cases of left pneumonectomy. They consider that herniation on this side occurs as a result of the probing action of the tip of the left ventricle, and that retraction of the lower edge of the pericardium prevents the return of the heart to a normal position. They treated their case by immediate thoracotomy and complete removal of the pericardium from the left side of the heart. Higginson (1953) has also met with this complication in one of his four cases of right-sided herniation; this patient died as a result of uncorrected displacement of the heart. In two of Higginson's cases herniation occurred through a moderate-sized window; the precipitating factor in one case was pressure from the anaesthetist's bag while the skin was being sutured, and in the other case the performance of tracheal suction in the ward eight hours after the operation. Both these patients developed profound shock. In the two cases reported here these precipitating factors were not present, but the patient's restlessness and breath-holding while recovering from the anaesthetic may well have caused the herniation.

The free use of bronchial detergents, e.g., "alevaire" mist, and the prevention of bronchial infection and pulmonary oedema will reduce the severity of coughing post-operatively. These measures are especially important if the remaining lung is emphysematous.

One of Higginson's cases is instructive. After operative replacement of the heart and wide excision of the pericardium, the patient felt faint if he lay on the operated side during the first few days after operation. Hypotension and tachycardia developed. Allison (1946) has shown at necropsy that the pericardial space becomes obliterated by fine adhesions and the edges of the pericardium become adherent to the surface of the heart within three days of operation. Thus herniation of the heart is unlikely to occur if the patient is not allowed to lie on the operated side during the first three days after operation. This routine has been advised by Brock and Whytehead (1955) and has been our practice.

It is difficult to say whether the sudden displacement of the heart, the irritation of the heart and coronary vessels by the chest wall, or the compression of the venae cavae is responsible for the shock and chest pain. It is likely to be a combination of these factors. But it is certain that the development of sudden cardiac herniation does embarrass the action of the heart and therefore operative replacement becomes a matter of urgency. Recovery following herniation has been recorded by Bettman and Tannenbaum in one case and by Higginson in four cases. In all these cases the pericardium was widely excised at an immediate thoracotomy.

The following procedures may be used in cases of intrapericardial pneumonectomy in which it is thought likely that a herniation may occur.

(1) The whole of the pericardium may be excised so as to prevent a hole remaining through which the heart might herniate.

(2) The pericardial defect may be closed with a latticework of catgut (Tubbs, 1958).

(3) A pedicled graft of pleura may be used to close the pericardium. This is a simple procedure and an adequate amount of parietal pleura is readily available. We have done this in a number of cases, but it is difficult as yet to assess its value.

Summary

Two cases of herniation of the heart after a left intrapericardial pneumonectomy have been described. Attention is drawn to the early symptoms and typical radiological appearances.

The causes and precipitating factors have been analysed.

Methods of preventing and treating this complication have been discussed.

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