PERICARDIOMY is accepted today as the treatment of choice for patients afflicted with pericarditis and pericardial constriction. Since our method of operative handling of these patients differs somewhat from much of what has appeared in the literature, it was decided to review our entire series and to attempt to ascertain the long term results following pericardiectomy in the patients operated in the department of thoracic surgery at the University of Leiden from 1951 to 1964.

It is our contention that only the anterior surface of the right ventricle, the anterolateral surface of the left ventricle, and the inflow pathways to each ventricle require freeing from the restricting pericardium; we do not believe that restriction of the caval veins or of the atria are significant to the immediate or to the long term course of the patients. Finally, we make no attempt to liberate the diaphragmatic or the posterior surfaces of the heart. The heart is approached through an anterolateral incision in the left fifth intercostal space, with or without dividing the sternum. The validity of this contention has been borne out by this study, wherein no patient has required a second operation, and the mortality and morbidity rates, both early and late, compare favorably with those reported from other centers.

MATERIALS AND METHODS

There were 42 patients on whom partial pericardiectomy was carried out in this department prior to January 1, 1964. There were 26 men and 16 women in this series, with ages ranging from 8 to 67 years, distributed as shown in Table 1.

The diagnoses in these patients were constrictive pericarditis in 36 cases, exudative pericarditis in five cases, and post-pericardiomy pericarditis in one case. Exudative pericarditis is, in essence, chronic cardiac tamponade due to pericardial exudate, which produces most of the same symptoms and the same hemodynamic effects as fully developed pericardial constriction. The patient who developed post-pericardiomy pericarditis had been operated 11 months earlier for closure of an atrial septal defect; throughout his postoperative period he exhibited massive, recurrent pericardial effusions. This is also an example of chronic, recurrent cardiac tamponade, and we have grouped it with those cases of exudative pericarditis.

Two patients had previous pericardiectomy elsewhere, four months and eight years earlier, respectively; neither patient had been relieved of his complaints by the first operation. At the second procedure, the former required only the liberation of the inflow tract of the right ventricle, while in the latter, it was evident that only a "button" of pericardium, approximately two inches in diameter, had been removed over the anterior surface of the right ventricle, and partial pericardiectomy, as described above, was carried out.

Thirty-two long term survivors have been evaluated annually or semi-annually in the outpatient unit of the department of cardiology. The follow-up period ranges from one to 13 years. Two additional pa-

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**Professor and Chairman, Department of Thoracic Surgery.
tients were lost to follow-up one month and six months, respectively, following surgery. There were eight deaths in our series. Three occurred in the immediate postoperative period, while five occurred five months, one and one-half years, two years, and one-half years, and eight years, respectively, after surgery.

RESULTS

Preoperative Evaluation

The preoperative findings in these patients conformed, in general, with those described in the literature and in standard texts.

The most common complaint was that of exertional dyspnea, present in 30 cases. Among the most frequently encountered indications of cardiac constriction were abnormal electrocardiograms in 40 of 41 cases so evaluated. One patient did not have a preoperative electrocardiogram.

There were low to negative T waves in 33 of the 41. We noted 12 instances of atrial fibrillation, one of atrial flutter, one of sinus tachycardia, and one of a gallop rhythm associated with right bundle branch block. Liver enlargement was present in 41 of 42 cases, but ascites was present in only 16. The systolic blood pressure was less than 130 in 35 patients, while the pulse pressure was decreased in 19; engorgement of the veins of the neck was present in 31; venous pressure was elevated in 34 of the 35 patients in whom it was recorded, and failed to return to its previous level within 30 seconds following exercise in each of the 25 cases so tested. Fourteen patients were noted to have a third heart sound.

Venæ caval and right atrial pressures were elevated in all 31 patients who underwent cardiac catheterization; right ventricular end-diastolic pressure was elevated in 27 of these 31, averaging 13.4 mm.Hg. Pulmonary wedge pressure was elevated in 26, averaging 16.0 mm.Hg. The ratio between the right ventricular end-diastolic and systolic pressures as described by Yu et al. was greater than one third in 22 of 27 cases, excluding those grouped as exudative pericarditis. A quiet heart, although not a small one, was found in 40 of the 41 patients so recorded. Pleural effusion, surprisingly, was present in only 18 cases.

Operative Findings

Calcification of the pericardial sac was found at surgery in 17 cases. In all 42 cases, a partial pericardietomy was performed, as described in the introduction of this paper. The right and left ventricle were freed, the pericardium resected over the largest part of these ventricles, but calcification on the diaphragm was left in place after freeing of the ventricles. No special attempt was made to free the whole of both auricles; only the ring between auricle and ventricle (mostly narrowed) was always divided, the adjacent auricular wall only if it was easy to do so.

Three patients had an additional operative procedure at the same thoracotomy; one mitral commissurotomy and two left pulmonary decortications were carried out without incident.

Hospital Mortality

The three deaths in the immediate postoperative period will briefly be reviewed.

CASE 9:

A 50-year-old man with the diagnosis of constrictive pericarditis, died of cardiac failure on his 43rd postoperative day, following a stormy course in which he suffered pulmonary embolus and staphylococcal empyema, from both of which he apparently recovered. At operation, the epicardium was noted to be edematous. Post-mortem examination revealed active tuberculosis and atrophy of the right ventricular myocardium. Comment: despite antituberculosis therapy with streptomycin and para-aminosalicylic acid of eight months duration, his infection was uncontrolled, and his signs of cardiac compression were marked. Considering that he had symptoms for only one year, the atrophy of the myocardium indicates the gravity of this condition.

CASE 38:

A 38-year-old man with the same diagnosis and symptoms of one year's duration, expired 12 hours following surgery due to myocardial failure. He had received prednisone for four months prior to admission to this hospital for the treatment of suspected viral myopericarditis. At post-mortem examination both pericardial and myocardial tuberculosis were found. Comment: It is felt that the prednisone therapy may well have permitted reactivation of an old tuberculosis, since granulomatous lesions consistent with tuberculosis were found in the lung and spleen. Earlier surgical intervention might have altered the final outcome in both of these cases.

CASE 41:

A 56-year-old man with symptoms of one year's duration, expired on the 17th postoperative day. No cause of death could be definitely determined at the postmortem examination. This man developed a paralytic ileus on the third postoperative day, which persisted until the tenth day, at which time peristalsis was heard, and defecation occurred. On postoperative day 15, he suddenly be-
came comatous and died 48 hours later. Comment: It is felt that this death was unrelated to the pericarditis or to the pericardiectomy, per se, but was due to a complication which could attend any major surgical procedure on this patient at this time.

These cases make up 7 per cent of the series.

Pathologic Findings

In eight cases, the pathology report revealed evidence of tuberculosis in the pericardium or myocardium. Two of the three deaths in the immediate postoperative period were among these eight.

In 31 cases, the pathologic specimen was variously described as chronic, proliferative, fibrous pericarditis or hyalinization of the pericardium. Three pathology reports were not available.

Postoperative Complications

There were eight postoperative complications in this series, as shown in Table 2.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number</th>
<th>Final Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemothorax</td>
<td>3</td>
<td>Uneventful recoveries</td>
</tr>
<tr>
<td>Pleural effusion</td>
<td>2</td>
<td>Uneventful recoveries</td>
</tr>
<tr>
<td>Paralytic ileus</td>
<td>1</td>
<td>Patient expired</td>
</tr>
<tr>
<td>Empyema</td>
<td>1</td>
<td>Patient expired</td>
</tr>
<tr>
<td>Psychotic reaction</td>
<td>1</td>
<td>Uneventful recovery</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Follow-Up Study

Thirty-nine patients were discharged from the hospital; there were three hospital deaths, as described above. Thirty-seven were followed for periods ranging up to 13 years; two patients were lost to follow-up. There were five late deaths in our series, as shown in Table 3, which will be briefly described.

<table>
<thead>
<tr>
<th>Case Number</th>
<th>Cause of Death</th>
<th>Post-operative Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>&quot;Pulmonary Inflammation&quot;</td>
<td>2½ years</td>
</tr>
<tr>
<td>17</td>
<td>Unknown*</td>
<td>8 years</td>
</tr>
<tr>
<td>18</td>
<td>Bronchogenic carcinoma</td>
<td>2½ years</td>
</tr>
<tr>
<td>21</td>
<td>Serum hepatitis*</td>
<td>5 months</td>
</tr>
<tr>
<td>42</td>
<td>Bronchogenic carcinoma</td>
<td>1½ years</td>
</tr>
</tbody>
</table>

*Post-mortem examination not obtained.

Cases 18 and 42 died two and one-half and one and one-half years, respectively, after pericardiectomy, of bronchogenic carcinoma. No evidence of this had been present at the time of the earlier surgery.

Case 16, who had a coexistent mitral stenosis surgically treated at the time of the pericardiectomy, died at home two and one-half years later of "pulmonary inflammation." Postmortem examination was not permitted. On the basis of our records, it is not possible to determine the role played by either the mitral stenosis or the pericarditis in this patient's death, but it should be noted that she showed marked improvement for one year postoperatively.

Case 17 died suddenly eight years after surgery while on vacation. He had been classed as good at his last follow-up visit, seven years after surgery. Postmortem examination was not obtained.

Case 21 died five months postoperatively. According to his family physician, he showed definite improvement for four months until he developed serum hepatitis and died within one month. No postmortem examination was obtained.

It is evident from the above that none of these late deaths could be attributed to persistent or recurrent cardiac constriction.

Postoperative Evaluation

Of the remaining 34 patients discharged from the hospital, 32 have been followed up in the department of cardiology at the University of Leiden, and two have been lost to follow-up. The period of observation ranged from one to 13 years, with an average of 92 months, or 7.7 years. All patients included in the follow-up study have been seen within the past two years.

Four patients had subjective complaints at their most recent visit, as shown in Table 4, and described briefly below, none of which was cardiac in nature.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Complaints</th>
<th>Length of Follow-up</th>
<th>Present Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Dyspnea—severe**</td>
<td>10 years</td>
<td>Fair</td>
</tr>
<tr>
<td>24</td>
<td>Dyspnea—mild</td>
<td>6 years</td>
<td>Good</td>
</tr>
<tr>
<td>30</td>
<td>Dyspnea—mild</td>
<td>4 years</td>
<td>Good</td>
</tr>
<tr>
<td>37</td>
<td>Fatigue and rheumatic pains</td>
<td>3 years</td>
<td>Good</td>
</tr>
</tbody>
</table>

**Patient with pulmonary emphysema.

Subjective Complaints

CASE 11

A 43-year-old man, has been followed for ten years. Examination during the ninth year confirmed the good results he experienced through-
out that period, during which he was asymptomatic. Re-examination during his tenth year revealed marked dyspnea, cough, liver enlargement and a right bundle branch block. Pulmonary function testing demonstrated severe pulmonary emphysema to be the cause of his symptoms. Thorough investigation failed to reveal any evidence of cardiac compression.

**CASES 24 AND 30**

A 50-year-old man, and a 48-year-old woman each complained of minimal, occasional dyspnea, but each is able to carry on his daily work without incapacity. There was no evidence of cardiac compression at repeated follow-up examinations. The clinical condition was classed as good in each.

**CASE 37**

A 48-year-old epileptic woman, improved somewhat following her hospital discharge, but she has never been free of complaints. During the past year she complained of easy fatigability and rheumatic discomfort in the fingers and hips. She has no subjective or objective signs of cardiac failure or of constriction of the heart. Another cause is being sought for the fatigability.

**Objective Findings.**

Measurement of the venous pressure was carried out in 26 of the 32 patients followed, and it was found to be within normal limits in all of them. While the number is too small to be significant, it was noted that the time for the venous pressure to return to a normal level following exercise was markedly decreased in all nine patients so examined, although it was not completely normal in all of them. The liver was palpable in seven of 32 cases. This ranged from a palpable edge to two fingers below the costal margin. In only one of these, however, were there any complaints, and this patient was the one found to have pulmonary emphysema. There was no instance of ascites or ankle edema. Cardiac pulsations on fluoroscopy were within normal limits in 31 of the 32 patients, while Case 1, asymptomatic with no physical signs of disease 13 years postoperatively, demonstrated a decrease in pulsations over the right ventricle; the left ventricle, which showed no pulsations preoperatively, pulsed normally.

Of 14 patients exhibiting a third heart sound preoperatively, in ten it was absent postoperatively; in two it was present intermittently, and in two it was constantly present.

Preoperative and postoperative electrocardiograms were available for comparison in 31 of 32 cases. All showed at least one abnormality of the same general types as did the preoperative tracings. There was no significant alteration of the voltage in the postoperative studies. The T waves showed improvement toward the normal in 19 instances, and remained the same in 12. Postoperatively, sinus rhythm was present in 84 per cent of the patients followed, where preoperatively it had been present in 64 per cent. Two of the patients exhibiting atrial fibrillation preoperatively had converted to and maintained a sinus rhythm at their last examination, as had one patient with a 3:1 atrial flutter prior to surgery. Two of the patients with a sinus rhythm also showed a right bundle branch block. The patient who had no preoperative tracing had a sinus rhythm postoperatively.

The pulse pressure increased postoperatively in 27, decreased in four, and remained the same in one patient.

No significant difference could be found postoperatively between those cases diagnosed as constrictive and those grouped as exudative pericarditis.

**Discussion**

Of the three early deaths encountered, two were cardiac in nature, as a direct result of their disease. One was due to metabolic complications not directly related to either constrictive pericarditis or to pericardiectomy, as such. This hospital mortality of 7 per cent compares very favorably with those reported from other centers. More late deaths in this series, comprising 12 per cent of the total. Insofar as we could judge, however, these deaths were unrelated to either the cardiac constriction or to the surgery; we, therefore, feel that our late mortality figures also compare well with those reported elsewhere.

No patients, in our hands, have required reoperation for this condition. In the long
term follow-up of 32 of the patients, 28 are free of complaints of any type (88 per cent). Among the remaining four with complaints, all have been repeatedly examined, and we have been unable, in any case, to find any objective evidence of recurrent constriction, nor could we find evidence of cardiac disease of any kind, other than the typical electrocardiogram findings postoperatively and one instance of a right bundle branch block in the patient with pulmonary emphysema.

The evaluation of the objective findings in this review gives further evidence of the adequacy of our operative handling of this condition. The decrease in the postoperative venous pressure demonstrates this well, and although it was not regularly utilized, we feel that one of the most important indicators of cardiac constriction is the time required for the venous pressure, after exercise, to return to its previous level. It was elevated in all 25 cases so examined preoperatively, and further, it showed a marked reduction in each case checked postoperatively, although it did not reach the normal of 30 seconds or less in any case.

Of the 32 patients evaluated fluoroscopically, decreased cardiac pulsations were noted to be present in only one patient, further limited in this case to the right ventricle. This patient, 13 years postoperatively, was without subjective or any other objective evidence of disease. His left ventricle, which showed no pulsations preoperatively, pulsed normally.

The only physical finding which could be associated with persistent or recurrent pericardial constriction of the heart was a palpable liver in seven cases. Considering the numerous factors capable of causing this, as well as the variations within the normal, and considering further that the only one of these seven who had any complaints, whatsoever, was the patient with pulmonary emphysema, we do not feel that this finding can be considered an indictment of our philosophy, particularly since it was present in virtually every case prior to surgery.

The electrocardiogram findings postoperatively, while still not normal in any case, showed improvement or remained stationary in all cases. Finally, the increase in the pulse pressure in 88 per cent of the patients postoperatively lends further credence to our conclusion.

Other than the presence of pericardial fluid in all six cases of exudative pericarditis, there were no significant differences between the exudative and constrictive pericarditis groups in the preoperative, operative and postoperative findings in this series. Neither were there any significant differences found in the three patients less than 17 years of age.

Therefore, in view of the low operative mortality, the absence of recurrence and of related late mortality and the very satisfactory long term results demonstrated by this study, we feel that our philosophy, in which a limited resection, in addition to being a thoroughly adequate resection, is a safer resection for the patient, has been amply justified by this review.

**Summary**

The presurgical data, the surgical findings and the results of the postsurgical evaluation in 42 patients treated with partial pericardietomy with follow-up over a period ranging from one to 13 years revealed no instance of persistent or recurrent cardiac constriction. The philosophy of a relatively limited resection in pericardial constriction of the heart is supported by this study.

**Acknowledgment:** The authors wish to express their appreciation to Prof. H. A. Snellen and the members of the Department of Cardiology for the postoperative evaluation of these patients, as well as a special vote of thanks to Dr. J. Krant of the same department for his assistance and instruction in the preparation of this paper.

**Resumen**

Los datos prequirúrgicos, los hallazgos operatorios y la evaluación post-operatoria en 42 pacientes en los que se practicó la pericardiectomía parcial que fueron seguidos por un periodo de uno a trece años, han puesto de manifiesto la ausencia de cardiopatía constrictiva permanente o recidivante.
Las resecciones relativamente poco extensas en las pericarditis cardio-constitutivas aparecen justificadas por los resultados observados en este estudio.

Resumen
Les données pré-opératoires, les constatations lors de l'intervention et les résultats du bilan postopératoire chez 42 malades traités par péridiartectomie partielle avec surveillance s'étendant sur une période allant d'un an à 13 ans, ne révèlent aucun exemple de constrictión cardíaca persistente ou récidivante. Cette étude appuie la conception d'une résection relativement limitée dans la constrictión péridiartique.

Zusammenfassung
Die präoperativen Werte, operativen Befunde und die Ergebnisse der postoperativen Auswertung bei 42 mit partielle Pericardiakiektomie behandelten Patienten mit Nachbeobachtungszeiten zwischen 1 und 13 Jahren ergeben keinen Fall einer persistierenden oder rezidivierenden cardialen Konstruktion. Der wert einer relativ limitierten Resektion bei pericardialer Konstruktion des Herzens wird durch diese Ergebnisse bekräftigt.

Referenzen

For reprints, please write: Prof. A. G. Brom, Academisch Ziekenhuis, Leiden, Holland.

Contribution to the Study of Bronchopulmonary Mycetoma
A case of mycetoma of Aspergillus fumigatus with bronchial changes of cystic-bronchiectatic type is illustrated in its clinical, radiologic and anatomic-histologic aspects. The authors report on its hemoptic manifestations and evolution of pathologic alterations, an early phase in which the increase of the fungus colony prevails and a second in which perifocal parenchymal lesions manifest themselves. Early resection is recommended.

Pulmonary Artery Thrombosis
The diagnosis of chronic thrombotic occlusion of the right main pulmonary artery was established in a 42-year-old man with persistent effort dyspnea. Pulmonary thrombendarterectomy was subsequently carried out with restoration of flow to the right middle and lower lobes. The clinical and laboratory diagnostic features noted before operation and the course during a 30-month follow-up period are reviewed.

Heart Trauma
A case of myocardial contusion due to nonpenetrating chest injury in a 20-year-old man is described. The electrocardiogram demonstrated transient right bundle branch block followed by the pattern of anteroseptal infarction. The clinical course was relatively benign despite the electrocardiographic changes. The authors recommend serial electrocardiograms be obtained in all cases of chest trauma in order to recognize cardiac damage.