Pericardial Rub in Pericardial Effusion: Lack of Correlation with Amount of Fluid*

Walter Markiewicz, M.D.; Arieh Brik, M.D.; Gerald Brook, M.D.;
Yehouda Edoute, M.D.; Israel Monakier, M.D.; and
Ya'afa Markiewicz, M.Sc.

The relation between the amount of pericardial fluid and the presence of a pericardial rub was examined in 76 patients with echocardiographic evidence of pericardial effusion. A pericardial rub was noted in 4 of 13 patients with small pericardial effusion (less than 100 ml), in 23 of 40 patients with moderate effusion (100 to 500 ml), and in ten of 23 patients with a large effusion. No difference in the amount of fluid was demonstrated in the group of patients with a rub when compared to the group without one. There was a statistically significant relation between the presence of a rub and the cause of the effusion. No inference as to the amount of pericardial fluid should be drawn from the presence or absence of a pericardial rub.

A pericardial rub is frequently heard in patients with pericardial disease and is believed to be caused by friction of the diseased pericardial membranes. While it is recognized that a pericardial rub may be noted in patients with pericardial effusion, the presence of fluid between both layers of the pericardium is thought to reduce the incidence of this auscultatory finding. This study evaluates the relationship between the amount of pericardial fluid, as detected by ultrasonic examination of the heart, and the presence of a pericardial rub.

**MATERIAL AND METHODS**

Two thousand successive patients were examined at the echocardiography laboratory of the Rambam Medical Center between March 1976 and March 1978. Patients with pericardial fluid secondary to heart failure were not included, since the effusion of heart failure is not, as a rule, associated with the auscultation of a pericardial rub. Ninety patients had clinical and/or echocardiographic evidence of pericardial disease. Eight patients with echocardiographic evidence of pericardial thickening but no fluid, and six subjects with typical clinical evidence of pericarditis (including a rub) but no abnormal findings on the ultrasonic study were excluded. The remaining 78 patients, all of whom had pericardial effusion, were included in this study. There were 41 male and 35 female subjects with a mean age of 49.9 ± 2.1 years (SEM). Two subjects were below the age of 12.

Most patients with suspected pericardial disease seen at our institution are referred to our laboratory for ultrasonic examination of the heart, the exception being patients developing pericarditis following acute myocardial infarction who usually are not referred.

Patients were divided into two groups, depending on the etiology of the effusion (Table 1). Group A included 43 patients who had an acute form of pericardial disease, frequently with sudden onset, chest pain and fever. Group B included 33 patients who usually had a less acute, or a chronic form of pericardial disease.

M-mode echocardiograms were performed using one of two different ultrasonoscopes and 2.25 or 3.5 MHz transducers with beam collimation to 7.5 cm depth. Echocardiograms were performed using standard techniques for optimal demonstration of pericardial echoes and were recorded. The criteria of Horowitz et al were used to diagnose and quantify pericardial fluid. Patterns C and D were considered positive for effusion. The amount of pericardial fluid present in patients with pattern D was calculated as the difference between the cubed diameter of the pericardium and epicardium at end-diastole (Fig 1). The amount of pericardial fluid present in patients with the C pattern is usually between 15 and 100 ml and cannot be estimated accurately by ultrasonic techniques. This amount was arbitrarily estimated to be 50 ml for use in statistical analysis. Confirmation of the diagnosis of pericardial disease was obtained in 22

<table>
<thead>
<tr>
<th>Table 1—Incidence of Pericardial Rub in 76 Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No.</td>
</tr>
<tr>
<td>Group A</td>
</tr>
<tr>
<td>Acute (idiopathic + viral)</td>
</tr>
<tr>
<td>Postirradiation</td>
</tr>
<tr>
<td>Postmyocardial infarction</td>
</tr>
<tr>
<td>Bacterial</td>
</tr>
<tr>
<td>Acute rheumatic fever</td>
</tr>
<tr>
<td>Others</td>
</tr>
<tr>
<td>Total group A</td>
</tr>
<tr>
<td>Group B</td>
</tr>
<tr>
<td>Neoplastic</td>
</tr>
<tr>
<td>Uremia</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
</tr>
<tr>
<td>Chronic effusion of undetermined etiology</td>
</tr>
<tr>
<td>Myxoedema</td>
</tr>
<tr>
<td>Total group B</td>
</tr>
</tbody>
</table>

*From the Departments of Cardiology and Internal Medicine, Rambam University Hospital, Aba Khoushy School of Medicine, Haifa, Israel.

Manuscript received June 4; revision accepted July 31.

Reprint requests: Dr. Markiewicz, Rambam University Hospital, Haifa, Israel

CHEST, 77: 5, MAY, 1980

PERICARDIAL RUB IN PERICARDIAL EFFUSION 843
I.

Echocardiogram demonstrating small anterior and large posterior echo-free space (pattern D). Line between solid arrows represents the total epicardial diameter whereas the line between the open arrows represents the total pericardial diameter. CW, indicates chest wall; AW, anterior wall; Ao, aorta; MV, mitral valve; LA, left atrium; En, endocardium; Ep, epicardium; and P, pericardium.

![Echocardiogram diagram](image)

patients (29 percent) either by pericardiocentesis (20 patients), surgery (9 patients), or post mortem examination (3 patients). In 15 patients, an attempt was made to completely remove the effusion during pericardiocentesis in order to correlate the aspirated volume with the volume calculated from an echocardiogram taken within 12 hours of pericardial aspiration.

Following the ultrasonic examination, a senior cardiologist performed a careful auscultation of the chest in the supine, sitting, and left decubitus position in all patients. Rubs with respiratory periodicity and no relation to the cardiac rhythm were excluded. For the purpose of this study, a pericardial rub was considered to be present when noted at the time of echocardiographic examination.

**RESULTS**

Thirteen patients had a small pericardial effusion

![Rub distribution diagram](image)

**Figures 2.** Distribution of pericardial rub according to amount of pericardial fluid in group A and group B patients. Amount of fluid (ml) has been rounded to nearest hundred. See text for definition of groups A and B.

- Group A, No Rub
- Group A, Rub
- Group B, No Rub
- Group B, Rub

**Figure 1.** Echocardiogram demonstrating small anterior and large posterior echo-free space (pattern D). Line between solid arrows represents the total epicardial diameter whereas the line between the open arrows represents the total pericardial diameter. CW, indicates chest wall; AW, anterior wall; Ao, aorta; MV, mitral valve; LA, left atrium; En, endocardium; Ep, epicardium; and P, pericardium.

![Echocardiogram diagram](image)
(less than 100 ml), and a rub was noted in four (31 percent) (Fig 2). Forty subjects had a moderate pericardial effusion (100 to 500 ml) and a rub was heard in 23 (58 percent). Of 23 subjects with a large effusion (over 500 ml), 10 had a rub (43 percent). Thus, a pericardial rub was noted in 37 of our 76 subjects with pericardial effusion (49 percent). Using the Wilcoxon two-sample rank test, no difference in the amount of fluid was demonstrated between the group of patients with a rub when compared to the group of patients without a rub ($U = 0.51$). This lack of significant correlation held for both A and B groups of patients. The calculated amount of pericardial fluid was 384.5 ml ± 47.6 ml (mean ± SEM) in the 37 patients with a rub versus 373.6 ml ± 49.5 ml in the 39 patients without a rub. A significant relationship was noted between the presence of a rub and the etiology of the pericardial effusion (Table 1). Thus, a rub was heard in 32 of 43 group A patients, but in only 5 of 33 group B patients ($P < 0.001$). There was a good correlation between calculated and measured amount of pericardial fluid among the 15 patients in whom these data were available (Fig 3).

**DISCUSSION**

In our group of patients with echocardiographic evidence of pericardial effusion, no relationship between the presence of a pericardial rub and the amount of pericardial fluid was found. This lack of relationship was evident in the whole group of 76 patients and also when the subjects were divided into subgroups according to the etiology of the effusion. Rather, a strong correlation evolved between the presence of a pericardial rub and the etiology of the effusion.

The paucity of data relating amount of pericardial fluid and audibility of a rub probably relates to the frequent difficulty in establishing the presence and in determining the amount of fluid present within the pericardial sac. Patients with pericardial effusion may have little clinical evidence of pericardial disease, and conventional chest x-ray film may not be helpful since 250 ml of fluid is said to be necessary to cause demonstrable changes in the cardiac size. M-mode echocardiography was used in this study since this technique is very sensitive and reliable in diagnosing pericardial effusion. Confirming the experience of Horowitz et al., we found a good correlation between the pericardial fluid volume calculated from the echocardiogram and the amount removed by pericardiocentesis. Whereas the quantification of the effusion is only an estimate of the amount of fluid present within the pericardial sac, such estimate is useful for comparative purposes. Real-time two dimensional echocardiography might have provided a better estimation of the amount and distribution of pericardial fluid within

![Figure 3. Correlation between calculated effusion volume determined from echocardiogram, and volume measured at pericardiocentesis.](Downloaded From: http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21139/ on 06/02/2017)
the pericardium,14 but it was not performed in this study.

A pericardial rub is commonly believed to be caused by the friction of the roughened pericardial surfaces across each other, and is heard in the majority of patients with inflammatory effusion.1,15 We recognize that pericardial rubs may be evanescent and that serial auscultation of our patients over a longer period of time might have provided additional information. Rubs occur at those phases of the heart cycle when most motion of the heart within the pericardium takes place.5 Whereas a rub is frequently heard in clinically "dry" pericarditis accompanied by a fibrinous exudate, it is commonly believed that effusion of increasing amount should reduce the incidence of pericardial rub, presumably by separating the pericardial layers, and therefore preventing friction. The exact location and mechanism of production of a pericardial rub is unclear, however, and persistence of a pericardial rub in the presence of large effusions, distending the pericardial sac, is well documented1,4 and might occur for various reasons. First, the visceral and parietal pericardium might remain in contact in areas of the heart not well visualized by M-mode echocardiography.14 Second, large effusions could cause little separation of the pericardial layers in the presence of an enlarged heart,18 thus allowing easy friction. This second possibility is unlikely in our series since only two of ten patients with large (over 500 ml) effusions and a pericardial rub had an enlarged right and/or left ventricle, as measured by echocardiography. Third, rubs need not be due to friction within the pericardial sac.14,17 Pericardial rubs might be produced by pericardial adhesions, be generated within the visceral pericardium alone, or be caused by friction between the parietal pericardium and the adjacent pleura or chest wall,1 and thus, in some patients, not be related at all to the presence and amount of pericardial fluid. Finally, exclusion of the six patients with clinical evidence of pericarditis (all of whom had a rub) and no echocardiographic evidence of pericardial fluid, might have biased the results. However, adding these six patients would have required the inclusion of patients with clinical and ECG findings suggesting pericardial disease in whom no rub was heard and no pericardial fluid was detected. Since it was difficult to prove the presence of pericardial disease in these subjects, we decided to limit our study to patients with pericardial fluid, in whom the diagnosis of pericardial disease was firmly established. Furthermore, inclusion of the six subjects with pericardial rub and no detectable fluid in the study group would not have altered the conclusion of this study since the lack of relationship between the presence of a pericardial rub and the amount of pericardial fluid would still be demonstrated (U = 0.63 using the Wilcoxon two-sample rank test, NS).

CONCLUSIONS

The presence of a pericardial rub is not related to the amount of pericardial fluid present in the pericardial sac. No inference as to the amount of pericardial fluid should be made from the presence or absence of a pericardial rub on clinical examination.

REFERENCES