Lactic Acid Levels in Pleural Fluid from Patients with Bacterial Pleuritis

THOMAS V. RILEY

Department of Microbiology, University of Western Australia, Queen Elizabeth II Medical Centre, Nedlands, Western Australia 6009

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Pleural fluid lactic acid estimations were carried out on 60 samples by gas-liquid chromatography. Lactic acid levels in 12 patients with bacterial pleural infection were statistically significantly higher (mean, 287 mg/dl; range, 135 to 482 mg/dl) than in 18 patients with malignancy (mean, 71 mg/dl; range, 24 to 157 mg/dl) and 30 other patients with pleural effusions (mean, 19 mg/dl; range, 10 to 57 mg/dl). The determination of pleural fluid lactic acid may help in differentiating between empyema and nonbacterial pleural effusions in most cases. It is of particular value when antibiotic therapy has commenced before specimen collection and may be useful for monitoring therapy.

Pleural effusion is a common complication of many diseases. It is important to differentiate inflammation due to bacteria from that due to other factors. Hence, the microbiological examination of pleural fluid is a frequent request after thoracentesis. It has been suggested that lactic acid levels are useful in differentiating septic from nonseptic conditions in cerebrospinal fluid (2, 5) and synovial fluid (3, 7). Brook (1) used the Monotest Lactate Kit to show that pleural fluid lactic acid levels were higher in bacterial infection than in noninfected cases, except malignancy. However, recently Bruun et al. (4) reported that pleural fluid lactic acid was of little diagnostic value in the differential diagnosis between empyema and nonbacterial pleural effusions. Because of this diversity in opinion, a further evaluation of pleural fluid lactic acid levels for the diagnosis of bacterial pleural infections was carried out.

Used in the investigation were specimens of pleural fluid collected from patients at the Sir Charles Gairdner Hospital, a 700-bed general hospital. They had been collected into sterile 50-ml plastic containers and were being submitted for routine microbiological examination. Based on medical records, the patients were grouped into the following three major categories: group 1, infection; group 2, malignancy; and group 3, others.

A gram-stained smear of the pleural fluid was prepared, and the fluid was cultured for aerobic and anaerobic bacteria by conventional techniques (6). Lactic acid estimations were performed by gas-liquid chromatography as previously described (7). When lactic acid levels could not be done immediately, specimens were frozen at −20°C until analyzed.

A comparison of pleural fluid lactic acid levels in the three groups of patients studied is shown in Table 1. All patients with bacterial pleuritis (group 1) had lactic acid levels of >135 mg/dl (range, 135 to 482 mg/dl).

The organisms isolated from these patients included Staphylococcus aureus and Peptostreptococcus productus (two of each); Streptococcus intermedius, Streptococcus pneumoniae, and Peptostreptococcus sp. (one of each); and one mixed culture of Streptococcus intermedius, Bacteroides sp., and Fusobacterium sp. In three cases organisms (gram-positive cocci) were seen in the Gram-stained smear, but were not isolated. In all three cases antibiotic therapy had been instituted before specimen collection. In a single case, with a lactic acid level of 205 mg/dl, bacteria were neither seen nor cultured. Clinically this patient had an empyema and responded to therapy with ampicillin and cloxacillin.

Lactic acid levels were slightly elevated in patients with malignancy of the pleural cavity (group 2) with a range of 24 to 157 mg/dl. Four patients in this group had pleural fluid lactic acid levels of >100 mg/dl. Patients in group 3 had lactic acid levels ranging from 10 to 57 mg/dl. Although there was some overlap between the three groups, there were statistically significant differences between group 1 and group 2 (t = 6.8248; P < 0.001) and group 2 and group 3 (t = 5.9207; P < 0.001). Repeat lactic acid estimations on patients with proven bacterial pleuritis demonstrated that pleural fluid lactic acid levels remained elevated for a considerable time after effective chemotherapy had commenced.

The data shows that high levels of pleural fluid lactic acid correlate with infection. Therefore pleural fluid lactic acid measurement can provide a useful adjunct to conventional bacteriological techniques in the diagnosis of infection. All patients with bacterial pleuritis had markedly raised pleural fluid lactic acid levels, including patients who had negative culture results due to previous antibiotic therapy.

There were four patients in the malignancy group who had lactic acid levels that overlapped with the infection group. Apart from these four, the remainder in the malignancy and other groups had lactic acid levels of <100 mg/dl. Hence, lactic acid estimation could distinguish between bacterial pleuritis and inflammation due to other causes in most cases. Despite the amount of overlap between the infection and malignancy groups, a lactic acid level of >100 mg/dl should be highly suggestive of a bacterial infection.

Pleural fluid lactic acid levels would appear to be particularly useful when antibiotic therapy has been started before the specimen is collected. High levels of lactic acid were demonstrable for several days after chemotherapy was commenced. Serial estimations may be of value in monitoring therapy.

A gas-liquid chromatography method was chosen in preference to a lactate dehydrogenase kit method for two reasons. First, many large microbiology laboratories now have access to gas-liquid chromatography equipment due to an increased interest in anaerobic bacteriology. Second, the lactate dehydrogenase kit method is relatively expensive and
TABLE 1. Pleural fluid lactic acid concentrations in 60 patients

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of patients</th>
<th>Lactic acid (mg/dl (mean ± SD)</th>
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</thead>
<tbody>
<tr>
<td>1. Infection</td>
<td>12</td>
<td>287 ± 118</td>
</tr>
<tr>
<td>2. Malignancy</td>
<td>18</td>
<td>71 ± 44</td>
</tr>
<tr>
<td>3. Others*</td>
<td>30</td>
<td>19 ± 13</td>
</tr>
</tbody>
</table>

* Includes: trauma (20 patients), systemic lupus erythematosus (2 patients), congestive heart failure (2 patients), and undiagnosed (6 patients).

has a limited shelf life. Although the kit method does have an advantage when only a small amount of specimen is available, this is not usually a problem with specimens of pleural fluid.

The results are similar to those reported by Brook (1) with the Monotest Lactate Kit. A mean pleural fluid lactic acid level of 19 mg/dl in those patients without infection or malignancy was recorded in both studies. However, there are some significant differences. The mean pleural fluid lactic acid level in patients with infection (287 mg/dl) was higher than the figure of 81 mg/dl reported by Brook (1). This discrepancy is unlikely to be due to differences in methodology, as Brook and Controni (3) have shown previously that the Monotest Lactate Kit and gas-liquid chromatography are equally reliable for the estimation of lactic acid. Consequently, in contrast to Brook’s report (1), there was a statistically significant difference between pleural fluid lactic acid levels in patients with infection and malignancy. Although Bruun et al. (4) agreed that pleural fluid lactic acid levels were higher in patients with infection, they found that there was considerable overlapping between groups of patients. This was not apparent in the present study, and only four patients from the malignancy group overlapped into the infection group. No patient in the infection group had a lactic acid level of <100 mg/dl. Mean lactic acid levels in both patients with infection and patients with malignancy were significantly higher than in the remaining group of patients.

In conclusion, pleural fluid lactic acid levels may be useful in the differentiation between infectious and noninfectious pleuritis. They may be of particular value when antibiotic therapy has commenced and routine microscopy and culture are negative. Serial lactic acid levels may be helpful in monitoring therapy. Gas-liquid chromatography is available in many laboratories and offers a rapid and reliable technique for the estimation of lactic acid.

LITERATURE CITED