Infections through blood from heart-lung machine

W. CH. P. GELDOF and A. G. BROM

Department of Thoracic Surgery, University Hospital, Leiden, The Netherlands

Of 657 cultures of blood from the heart-lung machine during operations performed with extracorporeal circulation, 16 (2.4%) proved to be positive. Of these 16 patients, 12 showed no clinical infective symptoms. The case histories of the remaining four patients are presented. In three of these cases a plausible explanation for the infected perfusion blood was found: an infected aortic aneurysm, an infected aortic valve prosthesis, and mediastinitis. In only one case was the cause of the infection sought in the heart-lung machine.

MATERIAL AND METHODS

In an effort to establish whether the cause of post-operative infection in patients who had undergone surgery with extracorporeal circulation was to be found in the heart-lung machine the following study was carried out.

In nearly all patients treated surgically with extracorporeal circulation over a period of four years—1 April 1967 to 1 April 1971—cultures were made of blood taken from the heart-lung machine immediately after the completion of perfusion. For this purpose a needle was fixed to the arterial line and blood was collected in a sterile flask. This flask was kept in the refrigerator at +4°C for a period ranging from 0 hour to a few days, whereupon the blood was cultured. The blood cultures were continued for at least one week. The tubing of the heart-lung machine was sterilized with ethylene oxide. The oxygenators used were either the sterile disposable bubble oxygenator of Rygg-Kyvsgaard or the Temptrol oxygenator. All patients were given prophylactic antibiotic cover, which during the early period of the study consisted of 4 million units of penicillin and 1 g streptomycin every 24 hours from the eve of the day of operation, while during the later period we used 4 g cloxacillin (Orbenin) and 1 g kanamycin every 24 hours from the eve of the day of operation.

RESULTS

The number of cultures started in this way totalled 657, of which 16 (2.4%) proved to be positive; all the others (641) remained sterile. Of the 16 patients with a positive blood culture from the heart-lung machine, 12 showed no clinical manifestations of infection (Table I), and in these cases the positive finding had no therapeutic consequence. It is quite conceivable that contamination had occurred in these instances. It must be pointed out, however, that one of these 12 patients died immediately after operation. Another patient, who required another operation with extracorporeal circulation after a few weeks, on that occasion had a sterile culture of blood from the heart-lung machine. In several other cases, various subsequent cultures of blood taken under sterile conditions were started as soon as the result of the blood culture from the heart-lung machine was known. All these subsequent cultures remained sterile.

The bacteria cultured from the perfusion blood of these 12 patients are listed in Table II; it should be pointed out that two different micro-

| TABLE I
| TOTAL NUMBER OF CULTURES: 657 |
| No clinical symptoms: 12 |
| Positive cultures: 16 (2.4%) |
| Clinical symptoms: 4 |

| TABLE II
| BACTERIA CULTURED FROM 12 PATIENTS1 WITH NO CLINICAL SYMPTOMS |
|---------------------|---------------------|-----|-----|-----|-----|-----|
| Staphylococcus albus | Streptococci of the viridans group | Indifferent streptococci | Diptheroid rods | Gram-positive rods | Achromobacter | Pseudomonas |
| 2                   | 1                   | 1   | 3   | 2   | 2   | 1   |
| Alkaligenes faecalis | Sporiferous organisms |                 |               |               |               |       |
| 1                   |                     |                 |               |               |               |       |

1 The cultures of two patients yielded two different bacteria. (One patient died immediately after operation.)
organisms were found in the blood from two patients. It is a conspicuous fact that Staphylo-
coccus aureus was never identified.

The other four patients with a positive blood
culture from the heart-lung machine did show
clinical symptoms; and in three of them there
was an unequivocal explanation for the infected
perfusion blood. The micro-organisms found in
the perfusion blood of these four patients are
listed in Table III. Their case histories are briefly
discussed.

**TABLE III**

**BACTERIA FOUND IN FOUR PATIENTS WITH CLINICAL
SYMPTOMS**

<table>
<thead>
<tr>
<th>Organism</th>
<th>Counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sporiferous Organs</td>
<td>1</td>
</tr>
<tr>
<td>Proteus mirabilis</td>
<td>1</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>1</td>
</tr>
<tr>
<td>Yeasts</td>
<td>1</td>
</tr>
</tbody>
</table>

**CASE HISTORIES**

**CASE 1** Patient F. was a 3-year-old girl in whom a
patent ductus arteriosus had been ligated elsewhere
three months previously. There was marked post-
operative pyrexia, but the temperature returned to
normal after one week. Two weeks after the opera-
tion, however, acute pyrexia recurred with general
malaise and dullness to percussion over the left hemi-
thorax. The leucocyte count was 14,800 mm³, and the
ESR was 70–103 mm/hr. The chest radiograph revealed
some pleural exudate, and a round swelling was later
demonstrated at the site of the aortic arch.
Haemolytic Staph. aureus was repeatedly cultured
from blood samples obtained under sterile condi-
tions. With sensitivity as a guideline, the patient was first
given chloramphenicol (Globenicol) and subsequently
received cloxacillin (Orbenin) and probenecid. When
a systolic murmur, which extended into diastole,
developed angiocardiography was carried out and
disclosed an aneurysm at the site of the ligated ductus
arteriosus.

A second operation was then performed with extracorpo-
real circulation to close the defect in the aorta
at the site of the ligated ductus arteriosus. The sutures
of the first operation were removed and cultured,
yielding a growth of Staph. aureus. Culture of the
blood from the heart-lung machine remained sterile.
Postoperatively she remained afebrile, but severe
haemothorax developed, with total displacement of
the left lung. In view of this it was decided one week
later to re-operate with extracorporeal circulation,
because we assumed that suture leakage had occurred.
The operation disclosed that no new aneurysm had
developed and that the aortic suture was adequate. Proteus mirabilis was grown from the clots removed
as well as from the perfusion blood. The postoperative
course was uneventful apart from a marked wound
infection, from which P. mirabilis was likewise
cultured. The temperature remained normal; the
patient received cloxacillin medication for a long time
until she had made a complete recovery.

**CASE 2** Patient C. was a 57-year-old man who, some
18 months previously, had been treated for a severely
calciﬁed aortic stenosis by insertion of a Starr valve.
The postoperative period was beset by many comp-
lications. The patient was anuric for some time but
required no dialysis. Severe bronchitis occurred, and
dehiscence of the sternum necessitated re-suturing.
Next, persistent anaemia developed which was prob-
ably a result of mechanical haemolysis, although ins-
sufﬁciency of the valve was not demonstrable. The
patient was treated by multiple blood transfusions and,
during long periods, received large doses of various antibiotics. In view of residual inﬂammatory
symptoms, the sternum was re-explored.

Finally, unmistakable insufﬁciency of the Starr
valve occurred, and a re-operation was performed
with extracorporeal circulation, even though renal
function was still poor (serum creatinine 3.0 mg/ 100
ml). Part of the valve ring had loosened and was
resutured. Yeasts were cultured from the perfusion
blood. His postoperative temperature was initially
normal but after a week began to rise. Blood cultures
of samples taken under sterile conditions were
repeatedly found to contain yeasts. Micturition was
normal during the initial postoperative period but
gradually diminished until anuria developed. Dialysis
was started but the patient died in toxic anuria on
the twelfth postoperative day.

**CASE 3** Patient E. was a man aged 50 who, after inser-
tion of a Starr valve into the aorta, developed severe
wound infection and mediastinitis, as well as dehiscence
of the sternum. Culture of the blood from the heart-
lung machine remained sterile, but Klebsiella was
cultured from the wound. The sternum was resutured
when the wound infection had been arrested by con-
servative measures. Owing to strong adhesions between
the anterior wall of the right ventricle and the sternum,
a defect in the right ventricle occurred and a repair
was undertaken with extracorporeal circulation. Klebsiella
was then cultured also from the perfusion blood.
With sensitivity as a guideline, the patient was given
long-term postoperative treatment with antibiotics.
The postoperative course was initially favourable but
serious toxic symptoms recurred after about a month.
Blood cultures remained sterile but the patient finally
died in toxic anuria six weeks after the second opera-
tion.

**CASE 4** Patient Z. was a man of 47 in whom a
valvuloplasty of the tricuspid valve was performed
with extracorporeal circulation for tricuspid ins-
sufﬁciency, while at the same time a patent foramen
ovale was closed. Sporiferous organisms were cultured
from the perfusion blood. The postoperative tempo-
ture was markedly raised, and unmistakable symptoms of sepsis occurred. Sporiferous organisms were likewise cultured from blood samples taken under sterile conditions. Marked wound infection developed followed by severe right-sided empyema. At a second operation under antibiotic cover, the empyema was drained. Both sporiferous organisms and Paracolobactrum were cultured from the thorax. Guided by sensitivity, the patient was given protracted postoperative antibiotic therapy and finally made a complete recovery.

DISCUSSION

The case histories show that, in three of the four patients with a positive blood culture from the heart-lung machine and unmistakable infective symptoms, a reason could be found for the presence of bacteria in the perfusion blood. These three patients underwent surgery with extracorporeal circulation while an infection was present—an infected aneurysm of the aorta at the site of the ligated ductus arteriosus; an infected Starr valve in the aorta; and mediastinitis. Only in the fourth patient could the infection be ascribed to the extracorporeal circulation.

The incidence of infection as a result of extracorporeal circulation can therefore be described as very low, in spite of the complexity of this procedure which might be expected to entail a high risk of infection. Baffes et al. (1970) believe that this might be explained by dilution of the perfusion fluid in combination with the prophylactic antibiotics. This probably also explains why the other 12 patients with a positive blood culture from the heart-lung machine failed to show any clinical manifestation of infection.

Ankeney and Parker (1969) reported a much higher frequency of positive blood cultures after operations using the heart-lung machine (19.2% of 1,555 cultures from 383 patients). But in their series, too, the number of patients with inflammatory symptoms was much smaller than the number of patients with a positive blood culture from the heart-lung machine.

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