Do blood cultures need continuous monitoring so that clinical action can be taken outside normal working hours?

D A Murdoch, R J Koerner, G E Speirs, A P MacGowan, D S Reeves

Abstract
Many automated blood culture reading systems monitor bacterial growth 24 hours a day but it is unclear if reacting to prompts indicating bacterial growth outside normal laboratory hours is of clinical benefit. An analysis of 50 blood cultures from 43 patients which had organisms seen on Gram films and had triggered positive out-of-hours showed that examination of the Gram film altered management of seven patients and the results of culture or sensitivity testing altered that of a further four. However, after review, it was felt the clinical outcome would not have been influenced by earlier intervention in any of these patients. We therefore consider that an out-of-hours service for dealing with positive blood cultures is not justified in our hospital. This conclusion may not apply universally, especially in hospitals where potential pathogens show less predictable antimicrobial sensitivity patterns.

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Keywords: Continuous monitoring, blood cultures, out-of-hours service.

The introduction of automated systems allows blood cultures to be monitored continuously with, potentially, more rapid transmission of information to medical microbiologists and clinicians. However, very little has been published on the impact that such rapidly available data might have on clinical outcome. Southmead Hospital is a 1000 bed university associated hospital incorporating general medical and surgical specialties, obstetrics and gynaecology, as well as specialist services in renal medicine, orthopaedics, infectious diseases, clinical haematology, and neonatology. The automated blood culture system (Sentinel, Difco, East Molesey, UK) in use at Southmead Hospital only has staff available to follow up positive prompts between 0900 and 1700 hours each day (including weekends). We wished to determine whether the availability of an out-of-hours service would lead to significant changes in patient management and outcome, so we studied a sample of patients whose blood cultures first indicated potential bacterial growth outside normal working hours.

Methods
A computer based printout of culture positive out-of-hours blood samples between April and July 1992 was prepared. Forty three patients (50 positive cultures) out of 77 were studied; clinical records were not available for the remainder. For each patient, the following information was recorded: date of birth, clinical diagnosis, antibacterials (dose, route, frequency, dates of administration), details of the blood culture isolate, advice communicated to clinicians, and any change of therapy. An analysis was made of whether earlier communication would have altered management and ultimate outcome. An independent assessor (GES) examined the notes of the patients in whom earlier intervention might have influenced outcome.

Results and Discussion
The isolates from 19 episodes were judged to be contaminants or probable contaminants by medical microbiologists in consultation with their clinical colleagues. Of these, 17 were coagulase negative staphylococci (CNS), one a viridans streptococcus and one a mixture of Enterococcus faecalis with an aerobic spore bearer. One patient was started unnecessarily on flucloxacillin for a suspected Staphylococcus aureus infection which cultures subsequently revealed to be a CNS. Of the 31 clinically important episodes, three patients died within six hours; all were on antibiotics active against the organism isolated from their blood culture. The results of microscopy or culture altered the management of 11 (22%) patients.

Examination of the Gram film led to an immediate change in therapy for seven patients (table) but we considered that earlier intervention would not have affected outcome. Therapy was altered in four cases when the identity of the organism or its antibiotic sensitivities became known; earlier processing would have led to more rapid identification and sensitivity testing, with an earlier change in therapy. However, the delay caused by our existing policy did not lead to a significantly worse outcome in any of these patients. Apart from the increase in staff costs, monitoring blood cultures overnight would lead to many extra telephone calls to clinicians, many of which would not result in a change of therapy. Often the hard-pressed junior staff providing cover at night do not know all the clinical details of the patients and in these cases it is possible that unnecessary antibiotics might be administered for defensive reasons.

In conclusion, we do not consider that an out-of-hours monitoring service is justified in

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Neomycin blood agar as a selective medium for vancomycin resistant *Enterococcus faecium*

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This hospital. However, these conclusions do not necessarily apply generally. A recent survey of this hospital’s bacterial flora showed that its antimicrobial susceptibility patterns were stable and very predictable; gentamicin resistant Gram negative rods and methicillin resistant strains of *S. aureus* were very rare. In hospitals with higher rates of antimicrobial resistance, where empirical treatment is less likely to be effective, earlier processing of specimens with more rapid availability of sensitivity data could well be justified.


**Abstract**

Neomycin blood agar is commonly used as a selective medium for the isolation of vancomycin resistant enterococci from faeces; however, not all isolates are recovered using this medium, perhaps because the neomycin concentrations are too high. To test this hypothesis, the neomycin minimum inhibitory concentration (MIC) was determined for 27 vancomycin resistant *Enterococcus faecium* isolates, 14 from patients with leukaemia and 13 from patients on the renal unit. A further eight isolates that had been recovered from the faeces of patients on the renal unit on neomycin agar were also studied. Eleven of the 14 isolates from the patients with leukaemia showed equal recovery on neomycin agar and blood agar and had MICs of 64 mg/l. In three other isolates there was

**Casestudy:**

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Age (years)</th>
<th>Cause of septicemia</th>
<th>Treatment history</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91</td>
<td><em>Escherichia coli</em></td>
<td>Known <em>E. coli</em> UTI, being treated with cefuroxime + ampicillin (isolate sensitive). When Gram negative rods were seen in blood film, the dose of cefuroxime doubled and ampicillin stopped; rapid and complete response. Analysis: on appropriate treatment but probably not optimal for septicemia.</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>*Vibrio&quot; streptococcus&quot;</td>
<td>Intra-abdominal carcinoma; intravenous line infection. No improvement after 24 hours on cefuroxime (isolate sensitive). Changed to vancomycin (sensitive) when streptococci seen in blood culture, no response; responded to removal of line. Analysis: intravenous line infection not responding to antibiotics.</td>
</tr>
<tr>
<td>3</td>
<td>83</td>
<td><em>Klebsiella pneumoniae</em></td>
<td>Known carcinoma of bowel with secondaries, admitted with mild pyrexia, given cefuroxime (isolate sensitive); developed Gram negative shock and died. Active intervention 48 hours after admission considered inappropriate. Analysis: possible short term benefit of earlier intervention.</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td><em>Staphylococcus aureus</em></td>
<td>Postcardiothoracic surgery; empirical ampicillin + flucloxacillin for sternal wound infection. When staphylococci were seen in blood film, flucloxacillin increased, fusidic acid added. No complications. Analysis: appropriate empirical treatment but not optimal for septicemia; early intervention of minor benefit.</td>
</tr>
<tr>
<td>5</td>
<td>79</td>
<td><em>S aureus</em></td>
<td>Fracture of humerus, pin site infection; <em>S aureus</em> cultured from pin site on same day as staphylococci seen in blood film. Analysis: appropriate antibiotics started that day on basis of results of pin site culture.</td>
</tr>
<tr>
<td>6</td>
<td>62</td>
<td><em>K pneumoniae</em></td>
<td>Cancer of rectum with urethral obstruction, terminal care; cefuroxime (isolate sensitive) started when Gram negative rods seen in blood film, active management withdrawn four days later; patient died. Analysis: proactive intervention probably inappropriate.</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td><em>Salmonella typhi</em></td>
<td>Swinging pyrexia after foreign travel, not constitutively ill; ciprofloxacin (isolate sensitive) started when Gram negative rods seen in blood film. Full recovery. Analysis: No change in outcome.</td>
</tr>
</tbody>
</table>

**UTI = urinary tract infection.**

**Treatment changed after microscopy (n = 7)**

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</thead>
<tbody>
<tr>
<td>8</td>
<td>74</td>
<td><em>S aureus</em></td>
<td>Pancreatitis with central line in situ; on cefuroxime (isolate sensitive) for mild pyrexia. On identifivation as <em>S. aureus</em>, flucloxacillin started, central line removed; <em>S aureus</em> cultured from line tip. Analysis: earlier identification of minor benefit.</td>
</tr>
<tr>
<td>9</td>
<td>41</td>
<td><em>Pseudomonas aeruginosa</em></td>
<td>Chest infection, septicemia in cardiothoracic patient; empirical cefuroxime + gentamicin led to rapid defervescence. No change of treatment when Gram negative rods seen in blood film; when <em>P. aeruginosa</em> identified, patient well but changed to oral ciprofloxacin. Organism sensitive to ciprofloxacin and gentamicin. Analysis: rapid response to empirical treatment.</td>
</tr>
<tr>
<td>10</td>
<td>19</td>
<td>Coagulase negative staphylococcus</td>
<td>Premature septic infant; on empirical flucloxacillin + netilmicin (isolate resistant); changed to vancomycin (sensitive). Full recovery. Analysis: early change of minor benefit.</td>
</tr>
<tr>
<td>11</td>
<td>6</td>
<td>Coagulase negative staphylococcus</td>
<td>Premature septic infant; on empirical flucloxacillin + cefotaxime (isolate resistant); changed to vancomycin (sensitive) when sensitivities known. Full recovery. Analysis: early change of minor benefit.</td>
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