

Rationalising the ordering of blood cultures

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Abstract

In 1996 a project was undertaken to determine the clinical impact of blood cultures taken in the emergency department. It found that 1.6% of all blood cultures taken resulted in changes in patient management. In response to these findings, guidelines were developed for more appropriate utilisation of blood cultures. It was predicted that the guidelines would result in a reduction in test ordering of approximately 40% and an annual saving of approximately \$18 000. The guidelines were implemented in mid-1997. An audit of test ordering for the months of January to August 1998 shows a 53% reduction in the ordering of blood cultures.

Introduction

In hospital practice, blood cultures commonly form part of the investigation of patients with suspected infective processes. Their use is recommended by major medical texts for the investigation of a wide variety of conditions, but there is little evidence confirming their utility or clinical impact. The emergency department is a unique clinical environment and the indications for obtaining blood cultures from patients in the emergency department are even less clear. There are no clinical impact data specific to the emergency department practice setting and attempts to encourage informed use of this test are few (Salluzzo & Reilly 1991). It is the author's opinion that blood cultures are more often ordered out of habit in an almost Pavlovian response to the presence of fever or because 'the admitting registrar will want them' than for any expectation of clinical impact. This is difficult to justify in the current economic climate, particularly as this test carries some risk to staff in the form of needlestick injury and blood-borne infection.

Development of the guidelines for test ordering

When it was decided to attempt to base ordering of blood cultures from the emergency department on sound clinical evidence, a review of the literature was undertaken. There were no studies specifically looking at the emergency department setting. A small number of papers have been published looking at the clinical utility of blood cultures as a test (Chendrasekhar 1996; Clements & Stephenson 1996; Henke & Polk 1996; McMurray, Wrenn & Wright 1997). Methodological problems make it difficult to extrapolate their findings to the emergency department. In particular, these studies either focused on hospital inpatients or patients in intensive care settings, or have 'worked backwards' from discharge diagnosis.

In 1996 Western Hospital conducted a retrospective review of blood cultures ordered between September 1995 and June 1996, with the aims of establishing the proportion of blood cultures that yield a positive microbiological culture, determining what proportion of blood cultures taken in the emergency department impact on patient management, and developing guidelines for the appropriate ordering of blood cultures from patients in the emergency department.

The results of this study have been previously reported (Kelly 1998). The key findings were that of 1062 blood cultures taken during the study period, 92 (5%) yielded 'true' positive results. Of these only 18 (1.6%) impacted on clinical management. The cost per test resulting in a change of management was A\$1770, comparable to findings from the United States (Henke & Polk 1996).

Kelly (1998) also found the potential impact of selective test ordering was considerable. Refraining from taking blood cultures in cases where a direct specimen (such as urine, cerebro-spinal or joint fluid) was available would have reduced the number of tests ordered by 18%. A further 14% reduction could have been achieved if blood cultures were not taken in patients who did not require hospital admission. An additional 9% reduction was possible if this test was not performed initially for immunocompetent patients with 'typical' infections such as cellulitis, orchitis and dental infections.

A further reduction of 20% was possible if blood cultures were not taken routinely in immunocompetent patients with community-acquired pneumonia or patients with conditions associated with infections but not primarily infective, such as asthma or cardiac failure. Overall, selective ordering of blood cultures could result in an approximately 60% reduction in the number of tests ordered.

From these findings, the guidelines for ordering blood cultures were developed as shown in Table 1. It was estimated that the use of these guidelines would reduce the ordering of blood cultures by approximately 40%.

Table 1: Guidelines for ordering blood cultures in the emergency department

Blood cultures should only be taken if:

1. After clinical assessment, the patient's illness is thought likely to be bacterial in origin AND
2. No more direct specimen for culture (e.g. urine, wound swab, CSF, joint aspirate, etc.) is practical AND
3. The patient's condition is such that treatment as an inpatient is warranted.

Blood cultures **SHOULD NOT** be taken routinely from stable, immunocompetent patients with common or typical infections such as cellulitis, orchitis and community acquired pneumonia.

Impact of guidelines on patterns of test ordering

The guidelines were introduced into use in the study emergency department in mid-1997. They are displayed, in the form of a laminated notice, in each of the clinical treatment areas.

In order to determine the impact of the guidelines on the number of tests ordered, audit data were collected for the period January to August 1998. The data were collected by a member of the staff of the pathology department at the hospital. Staff in the emergency department were unaware that an audit was in place. In the three-month period prior to and during the audit, no specific activities were conducted to reinforce the implementation of the guidelines.

In the initial study period (prior to implementation of the guidelines), 1062 blood cultures were ordered in 279 days. This equates to 114 tests per 30-day period. In the audit period, 436 blood cultures were ordered in 243 days, equating to 53.8 per 30-day period. This represents a reduction of 53% in test ordering.

Discussion

Blood cultures are a commonly ordered test in emergency departments. There are several reasons for this behaviour, including habit, a perception that blood cultures should be taken because the inpatient unit will require them, and the fallacious belief that if they are not taken at presentation 'the boat has been missed'. In addition, there is a lack of appreciation of the sensitivity and specificity of blood cultures as a test. Studies have shown that in the presence of known major bacterial infection, blood cultures are only positive in up to 20%

of cases (Baraff 1996; McMurray, Wrenn & Wright 1997). The rate of false positive blood cultures is approximately 50% (Salluzzo & Reilly 1991; Kelly 1998).

At the study hospital, the cost per blood culture ordered is estimated at \$30. Based on the ordering pattern prior to introduction of the guidelines, the annual cost to the emergency department was of the order of \$42 000. The estimated annual saving based on the ordering pattern found in the audit is \$22 000.

The clinical impact of blood cultures must be compared to the clinical impact and cost of more direct tests such as CSF gram stain, culture and latex agglutination, urine and joint fluid culture, and swabs from skin lesions. With respect to CSF, the diagnostic yield of CSF culture ranges from 48 to 100%, depending on whether the patient has been pre-treated with antibiotics (Rodriguez et al. 1993; Bhisitkul, Hogan & Tanz 1994), direct gram stain has a yield of 74% (Rodriguez et al. 1993) and latex agglutination tests, 80% (Rodriguez et al. 1993). Used together, these three tests have been reported to have a diagnostic yield of 92% (Rodriguez et al. 1993). With respect to synovial fluid culture, cultures are positive in almost all cases of non-gonococcal bacterial septic arthritis (Lorei 1996). In gonococcal disease, synovial fluid culture is positive in 25% to 50% of cases, however, genital cultures increase diagnostic yield markedly (Lorei 1996). Regarding pyelonephritis, a positive urine culture is usually a defining criterion, so the sensitivity of urine culture approaches 100%.

The validity and effectiveness of clinical practice guidelines is controversial as there is conflicting evidence and opinion regarding their usefulness. Research to date suggests that, although guidelines are widely read, their recommendations are infrequently followed; that they influence knowledge but have little effect on attitudes or behaviour; and that associated cost reductions and improvements in care are difficult to quantify (Woolf 1993). Additionally, guidelines do not usually define optimal care with certainty because of inadequate scientific information and imprecise application of decision rules to individual patients (Woolf 1993). For example, Bezerra et al. (1992) demonstrated that the American Academy of Pediatrics guidelines on oral rehydration were being practised by fewer than 2% of physicians treating children. Similarly, a Canadian study showed no change in national caesarean section rates after release of clinical guidelines (Lomas et al. 1989). The guideline described in this paper has worked very well. Particularly pleasing is the sustained nature of the change in practice. Potential reasons for its success include that it was developed in the clinical environment in which it has been applied and that it is based on evidence rather than opinion.

The finding that blood cultures taken in the emergency department have very low clinical impact and that simple guidelines can successfully guide their use raises similar questions about other tests used frequently in emergency departments, such as abdominal x-rays for abdominal pain and full blood examinations for a wide variety of illnesses. We are challenged to understand the performance characteristics of the tests we use and their potential clinical impact in order to use them effectively and efficiently. This field is deserving of systematic research.

Conclusion

Blood cultures taken in the emergency department rarely yield positive cultures. Implementation of clinical impact based guidelines to limit ordering of blood cultures resulted in a 53% reduction in test ordering, with an estimated annual saving of more than \$22 000 per annum.

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