

## The additional value of blood cultures in patients with complicated urinary tract infections

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### Abstract

We evaluated 800 hospitalized patients with a complicated urinary tract infection, from whom both a blood and a urine culture were obtained on the first day of antibiotic treatment. Urine cultures were positive in 70% of patients, and blood cultures were positive in 29%. In 7% of patients, uropathogens caused bacteraemia with a pathogen that was not isolated from urine. Receiving antibiotic therapy at the moment of hospitalization was the only factor independently associated with discordant culture results (OR, 2.06; 95% CI, 1.18–3.61). For those receiving antibiotics at the moment of hospitalization, blood cultures have additional diagnostic value over urine cultures.

**Keywords:** Bacteraemia, culture (blood/urine), diagnostics, risk factors, urinary tract infection

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Bacteraemia is present in 15–25% of patients with complicated urinary tract infections (UTIs) [1]. In many UTI treatment guidelines, collection of blood cultures is not recommended

[2–4], as they may provide little additional diagnostic value over urine cultures [5–8]. In contrast, other authors recommend collecting blood cultures from all patients with a complicated UTI [9,10], or at least patients at risk of discordant culture results (i.e. bacteraemia with uropathogens that could not be cultured from urine) [11,12]. However, the risk factors for discordant culture results are not unambiguous [11,12]. The objective of the present study was to assess the rate of discordant culture results, and to identify for which group of patients collection of a blood culture seems useful.

We conducted a retrospective observational cohort study, which was part of the baseline measurement of a cluster-randomized trial testing a multifaceted antibiotic stewardship programme in patients with a complicated UTI. The details have been described before [13]. Briefly, the departments of internal medicine and urology of 19 hospitals located throughout the Netherlands participated. Included were adult inpatients/outpatients diagnosed with a complicated UTI, including uncomplicated pyelonephritis [13,14], who started antibiotic therapy. For the present study, we only considered those hospitalized patients for whom both a blood culture and a urine culture were obtained on first day of antibiotic treatment. In case a patient was admitted after 21.00, a urine culture obtained the next day was also accepted. The ethics committee deemed the study exempt from their approval.

Blood and urine cultures were considered 'positive' when a bacterial pathogen was regarded as pathogenic (at least 10E4 or 10E5 cfu/mL) by the attending microbiologist and reported together with a susceptibility pattern. Contamination was defined as culture results that were regarded and reported as 'contaminated' by the attending microbiologist, or a urine culture that revealed growth of at least three bacterial species. Coagulase-negative staphylococci isolated from a blood culture were also considered to represent contamination. Contaminated cultures were included in the analysis. A culture was defined as 'sterile' when it did not show any bacterial growth or when a bacterial pathogen was regarded as low pathogenic by the attending microbiologist.

Concurrent blood and urine cultures could be either discordant or concordant. A discordant culture result was defined as a positive blood culture with a related urine culture that showed growth of another microorganism, did not show bacterial growth, or was contaminated. In the case of discordant culture results a blood culture was considered to have 'additional value' over a urine culture. A concordant culture result was defined as a positive urine culture with a related blood culture that showed growth of the same microorganism, showed no growth, or was contaminated. Concurrent sterile or contaminated blood and urine culture results were considered 'concordant' as well. In the case of

concordant culture results a blood culture was considered to have 'no additional value'.

Of 1314 patients with a complicated UTI, 514 were excluded, mainly because blood and/or urine cultures had not been performed, but 800 were included (Fig. 1). Baseline characteristics are listed in Table 1.

The urine culture results showed one pathogen in 492 and two pathogens in 71 patients, accounting for 70% (563/800) of positive urine cultures. *Escherichia coli* (as a single pathogen) was the most common pathogen in positive urine cultures (63%, 355/563), followed by *Klebsiella* species (7%, 39/563). *Staphylococcus* species was cultured in nine patients (2%), namely *saprophyticus* (1%, 8/563) and *Staphylococcus saprophyticus* (0.2%, 1/563). Additionally, 2% contaminated (13/800) and 28% sterile urine cultures (224/800) were obtained.

The blood culture results showed one pathogen in 224 and two pathogens in five patients, accounting for 29% (229/800) of cultures revealing bacteraemia. *E. coli* (as a single pathogen) was cultured in 72% (164/229) and *Klebsiella* species in 7% (17/229). *Staphylococcus* species was cultured in 10 patients: *S. aureus* in 1% (3/229) and coagulase-negative staphylococci in seven patients, which was considered as contamination. Contaminated and sterile blood cultures were obtained in 3% (21/800) and 69% (550/800), respectively.

Overall, 7% (57/800) of the patients had discordant culture results. Of these patients, 28% (16/57) had a different bacterial species in the blood culture to that in the related urine culture,

whereas 72% (41/57) had bacteraemia with a related urine culture showing contamination or no bacterial growth (Fig. 1).

Potential risk factors (uni- and multivariate) for discordant culture results are shown in Table 1. Blood cultures were more often sterile in pretreated than in non-pretreated patients (74% vs. 65%;  $p$  0.01). Covariates associated with discordant culture results on univariate analysis at a level of significance of  $p < 0.2$  were included in a multiple logistic regression model using a forward procedure. Receiving antibiotic therapy at the moment of presentation was the only factor independently associated with discordant culture results (OR, 2.06; 95% CI, 1.18–3.61). Receiving antimicrobial treatment at the moment of presentation was associated with a 10.1% risk of having discordant culture results, compared with 5.4% without antimicrobial treatment (risk difference, 4.7%; 95% CI, 0.91–9.1%).

In summary, in 7% of patients uropathogens caused bacteraemia with a pathogen that was not isolated from the urine. Receiving antibiotic therapy at the moment of presentation doubled the risk of the presence of discordant culture results.

To our knowledge, our study has the largest sample size and is the first to evaluate the total, diverse population of patients with complicated UTIs. Receiving antibiotic therapy at the moment of hospitalization turned out to be the only independent risk factor, which confirmed the results of van Nieuwkoop *et al.* [12], but disagreed with Etienne *et al.* [11], who

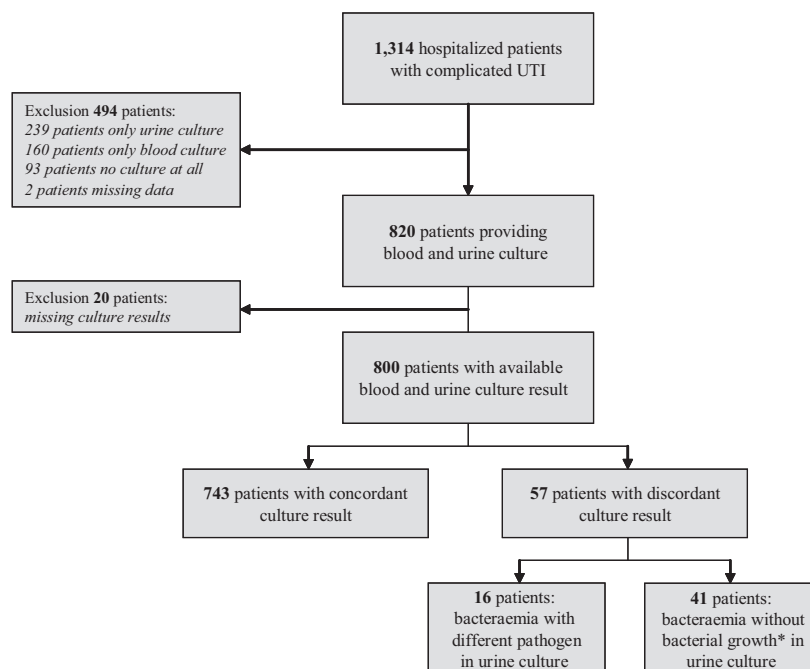


FIG. 1. Flowchart of patients. \*Or with contamination.

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