

Characteristics and Outcomes of *Staphylococcus aureus* Bloodstream Infection Originating From the Urinary Tract: A Multicenter Cohort Study

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Background. *Staphylococcus aureus* bloodstream infection (SABSI) arising from a urinary tract source (UTS) is poorly understood.

Methods. We conducted a retrospective analysis in 3 major teaching hospitals in Spain of prospectively collected data of hospitalized patients with SABSI. SABSI-UTS was diagnosed in patients with urinary tract symptoms and/or signs, no evidence of an extra-urinary source of infection, and a urinary *S. aureus* count of $\geq 10^5$ cfu/mL. Susceptibility of *S. aureus* strains and patient mortality were compared between SABSI from UTS (SABSI-UTS) and other sources (SABSI-other).

Results. Of 4181 episodes of SABSI, we identified 132 (3.16%) cases of SABSI-UTS that occurred predominantly in patients who were male, had high Charlson comorbidity scores, were dependent for daily life activities, and who had undergone urinary catheterization and/or urinary manipulation before the infection. SABSI-UTS was more often caused by MRSA strains compared with SABSI-other (40.9% vs 17.5%; $P < .001$). Patients with SABSI-UTS caused by MRSA more often received inadequate empirical treatment compared with those caused by susceptible strains (59.7% vs 23.1%; $P < .001$). The 30-day case fatality rate was lower in patients with SABSI-UTS than in those with SABSI-other (14.4% vs 23.8%; $P = .02$). Factors independently associated with mortality were dependence for daily activities (aOR, 3.877; 95% CI, 1.08–13.8; $P = .037$) and persistent bacteremia (aOR, 7.88; 95% CI, 1.57–39.46; $P = .012$).

Conclusions. SABSI-UTS occurs predominantly in patients with severe underlying conditions and in those who have undergone urinary tract manipulation. Moreover, it is frequently due to MRSA strains and causes significant mortality.

Keywords. bacteremia; *Staphylococcus aureus*; urinary devices; urinary tract infection.

Staphylococcus aureus is a leading cause of bloodstream infection and continues to be associated with high mortality [1–3]. A key predictor of mortality in patients with *S. aureus* bacteremia is the source of the infection, with some (eg, endocarditis) considered high-risk and others (eg, catheter-related)

considered low-risk sources for poor outcomes [2, 4]. These risk differences may be associated with the bacterial inoculum related to each source and/or with the possibility of achieving a prompt source control. Moreover, methicillin resistance has been associated with worse outcomes in patients with *S. aureus* bloodstream infection. The mean percentage of methicillin-resistant *S. aureus* in the European Union was 16.4% in 2018, although large differences in national percentages were observed, with 24% in Spain [5].

S. aureus bacteriuria is an uncommon finding, accounting for only 0.4%–4% of positive urine cultures [6, 7]. Although it may only represent urinary tract colonization in asymptomatic patients, it can also result from hematogenous seeding to the urinary tract. Indeed, *S. aureus* bacteriuria is present in about 7%–16% of patients with *S. aureus* bloodstream infection (SABSI), particularly in cases of endocarditis, and is considered

Received 21 February 2020; editorial decision 2 June 2020; accepted 3 June 2020.

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DOI: 10.1093/ofid/ofaa216

a marker of hematogenous seeding to the renal parenchyma [7–11]. Alternatively, *S. aureus* could be a true urinary pathogen among patients residing in long-term care facilities, carrying indwelling catheters, with urinary tract obstruction and/or malignancy, and following instrumentation [6]. These cases may therefore have developed an SABSI from an “ascending” urinary tract source (UTS) [12].

SABSI from a UTS (ie, SABSI-UTS) is an infrequent complication of urinary tract infections and accounts for only 3% to 6% of patients with SABSI [13, 14]. However, interpreting the frequency of SABSI-UTS is complicated because of difficulties in attributing an episode of SABSI to a UTS. Although the presence of *S. aureus* in the urine is important to note, this alone is insufficient to diagnose SABSI-UTS [10]. Instead, SABSI-UTS should only be considered in patients with SABSI, urinary tract symptoms and/or signs, no evidence of an extra-urinary source of infection, and an *S. aureus* count $\geq 10^5$ colony-forming units/mL in urine specimen. To date, the topic of SABSI-UTS has been largely overlooked, especially when using strict criteria [2, 15].

We aimed to improve our knowledge of the characteristics and outcomes of SABSI-UTS in a large cohort of clearly defined cases managed in 3 university teaching hospitals.

METHODS

Study Design, Setting, and Participants

This was a retrospective cohort analysis of prospectively collected data of adult patients (≥ 18 years old) with SABSI. Data were collected from 1996 to 2018 for 3 tertiary teaching hospitals in Spain: Hospital Universitari de Bellvitge, a 700-bed hospital for adults in Barcelona; Hospital Universitario 12 de Octubre, a 1300-bed hospital in Madrid; and Hospital Universitario Virgen Macarena, a 960-bed hospital in Seville. Patients with positive blood cultures were reported daily by members of the microbiology department and were seen and prospectively followed up by infectious disease specialists during their hospital admissions. Susceptibility of *S. aureus* strains and patient mortality were compared between SABSI from UTS (SABSI-UTS) and other sources (SABSI-other).

Variables and Data Source

Patients with SABSI were reported daily to the infectious disease team by members of the microbiology department for follow-up. Demographic, epidemiological, clinical, and microbiological data were collected from clinical charts for all patients with SABSI. The following data were recorded: age, sex, comorbidities, functional and immunological status, contact with the health care system, clinical data at the onset of bacteremia, recent procedures (eg, indwelling urinary catheters and/or urinary manipulation), microbiological reports, diagnostic procedures, therapeutic interventions, empirical antimicrobial

treatment, and outcomes. Follow-up data for up to 30 days after the onset of bacteremia were obtained to assess mortality by reviewing the patients’ electronic clinical charts. Data were included in a database and reviewed retrospectively for the purposes of this study.

Definitions

SABSI was defined as the presence of at least 1 positive blood culture obtained in a patient with clinical signs and symptoms of infection such as fever, shivering, and/or chills. In addition, SABSI-UTS was diagnosed in patients with SABSI by the presence of urinary tract symptoms and/or signs, the lack of a plausible extra-urinary source of infection, and the presence of an *S. aureus* count of $\geq 10^5$ colony-forming units/mL in a urine specimen. Urinary symptoms and signs included dysuria, flank or suprapubic pain, pyuria, or haematuria. Patients with SABSI and orchiepididymitis and/or prostatic abscess, even without a positive urine culture, were also included. All possible SABSI-UTS episodes were reviewed by 3 study investigators who were part of a 6-member clinical review panel (SG, GC, IG, JC, EL, JA). All members of the panel are specialists in infectious disease and have extensive clinical experience treating SABSI. The reviewers were asked to check the microbiology results and baseline urologic comorbidities and to exclude a potential alternative source of SABSI. The final decision regarding the inclusion or exclusion of each case was made by consensus.

Infection acquisition was categorized according to Friedman’s criteria [16]. The Pitt bacteremia score (Pitt score), a validated prognostic mortality factor, was used to assess the severity of bacteremia at onset [17]. Sepsis was determined according to whether the quick Sequential Organ Failure Assessment (qSOFA) score was ≥ 2 points. Patients with septic shock were identified clinically based on the need for vasopressors to maintain a mean arterial pressure of ≥ 65 mmHg and by the presence of serum lactate levels > 2 mmol/L (> 18 mg/dL) in the absence of hypovolemia [18].

Echocardiography was performed in patients with persistent bacteremia and in those with cardiac anomalies and/or with intravascular devices. An empirical antibiotic was defined as the antibiotic administered in the first 48 hours after a positive blood culture was drawn; it was considered appropriate if the strain was susceptible to ≥ 1 administered antibiotic based on current EUCAST breakpoints [19]. Adequate and early control of the source was considered to have been achieved when a drainage procedure was performed in the first 72 hours from the onset of SABSI, when this was feasible. Persistent bacteremia was defined as a positive blood culture for *S. aureus* at ≥ 3 days after appropriate antimicrobial treatment. Persistent positive urine culture was defined as the presence of any repeated positive urine culture for *S. aureus* during the 30-day follow-up. Susceptibility rates of *S. aureus* strains were obtained in cases of SABSI-UTS and SABSI-other.

Urinary tract procedures were classified as urethral catheter, ureteral catheter, nephrostomy, urinary diversion, or suprapubic cystostomy. Urinary manipulation was considered when a patient had undergone urinary tract handling within 30 days of developing bacteremia. Such procedures included urethral catheter insertion or change, nephrostomy, ureteric stent, ureterostomy, and urologic surgical procedure.

The Charlson comorbidity score was used to assess the role of underlying disease [20]. Dependency was classified as independent for daily life activities (ie, supervision or help was not essential for activity) or dependent for daily life activities (ie, some help was needed daily) [21]. Thirty-day mortality was defined as death due to any cause within 30 days after the onset of bacteremia.

Exclusion Criteria

Patients were excluded if urine was not collected for culture, if they had negative or no urine culture results, or if ≥ 2 different pathogens were isolated in a urine specimen with no evidence of *S. aureus*. Patients without complete follow-up data were also excluded from analysis.

Microbiological Studies

Two sets of blood cultures were collected for each bacteremia episode using BD BACTEC PLUS Aerobic/F plus Anaerobic/F or Lytic/10 Anaerobic/F mediums. The samples were processed in a BD BACTEC FX blood culture system (Becton Dickinson, Barcelona, Spain).

Urine samples were plated on CLED agar following standard procedures. *S. aureus* was identified by classical methods (latex agglutination and DNase production) or by MALDI-TOF (since 2013).

Antimicrobial susceptibility was determined according to the EUCAST guidelines by either disk diffusion method (urine samples) or microdilution (blood samples) using commercially available panels (MicroScan, Beckman Coulter, Barcelona, Spain) [19].

Statistical Analysis

All data were analyzed using SPSS software, version 15.0 (SPSS Inc., Chicago, IL, USA). Categorical variables are presented as number of cases and percentages, while continuous variables are presented as means and standard deviations or medians and interquartile ranges (IQRs). Continuous variables were compared by Student *t* tests or Mann-Whitney *U* tests, as appropriate. The Fisher exact test or Pearson's χ^2 test was used to assess the relationship between categorical variables. Multivariate logistic regression analysis was then used to assess the factors potentially associated with 30-day mortality. However, because of the low mortality rate, each variable found to be significantly associated with 30-day mortality in the univariate analysis was ultimately incorporated into multivariate models and adjusted

by 2 other variables considered strong predictors of mortality (age >70 years and Charlson comorbidity score >5 points). Goodness of fit was assessed by the Hosmer-Lemeshow test. Relative risks are expressed as adjusted odds ratios (aORs) and 95% confidence intervals. Statistical significance was established at $\alpha = 0.05$. All reported *P* values are 2-tailed.

Ethics

This research and manuscript were reviewed before publication by the Research Ethics Committee of Bellvitge University Hospital. Written informed consent was waived, as it was an observational and retrospective analysis of our usual clinical practice. All patient data were anonymized for the purpose of analysis, and confidential data were protected in accordance with appropriate national and European standards.

This paper was written in accordance with the STROBE Statement ([Supplementary Data](#)).

RESULTS

There were 4181 episodes of SABSI recorded during the study period, and of these, 154 (3.68%) were considered to be possible SABSI-UTS. A further 22 patients were excluded from analysis because they had >2 bacterial strains in urine culture (3 patients), no collected or negative urine culture (10 patients), or urine culture positive for microorganisms other than *S. aureus* (9 patients). The remaining 132 cases (3.16%) were considered definite cases of SABSI-UTS and were included in the final study ([Figure 1](#)).

The baseline characteristics of patients are summarized in [Table 1](#). Patients with SABSI-UTS were more frequently men, had a mean age of 67 years, and had a median Charlson comorbidity score of 5 points, with more severe dependency for daily activities. More than 40% of the cohort had solid cancer. The infections were nosocomial or health care-associated in $>70\%$ of cases, and 11% of patients had orthopedic prostheses or cardiac devices in place at the onset of bacteremia. Regarding the baseline infection severity, 23 patients had a Pitt score of >2 points, and 7 patients had septic shock at the onset of bacteremia.

As detailed in [Table 2](#), indwelling urinary devices were present in 94 patients (71.2%), 3 patients had urinary diversion, and urinary manipulation had been performed before SABSI-UTS in $>60\%$ of patients. Manipulation had been performed a median (IQR) of 9 (2–21) days before bacteremia, with urethral catheterization or change of urethral catheters being most common, followed by urinary surgical intervention and nephrostomy. [Figure 2](#) shows that catheter-associated urinary tract infection was the most common infection, followed by ascending pyelonephritis and obstructive pyelonephritis.

It was notable that SABSI-UTS was more often caused by MRSA strains than SABSI-other (40.9% vs 17.5%; $P < .001$). Patients with MRSA infection less frequently received

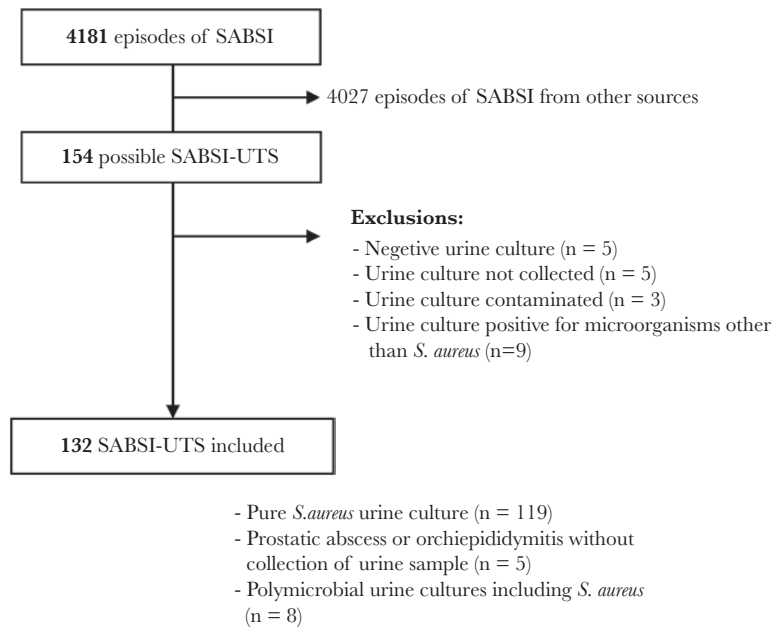


Figure 1. Study flowchart for the selection of patients with SABSI-UTS. Abbreviation: SABSI-UTS, *Staphylococcus aureus* bloodstream infection [from a] urinary tract source.

Table 1. Baseline Characteristics of Patients with SABSI-UTS

Variables	Patients With SABSI-UTS (n = 132)
Age	
Mean (SD), y	67.39 (15.60)
Median (IQR), y	70.0 (57.25–79.85)
Age >65 y	87 (65.9)
Male sex	116 (87.9)
Comorbidity	
Charlson comorbidity score	
Mean (SD)	5.14 (2.65)
Median (IQR)	5 (3–7)
Charlson comorbidity score >5	60 (45.5)
Dementia/neurologic disorders	
Chronic obstructive pulmonary disease	21 (15.9)
Chronic cardiac disorders	22 (16.6)
Chronic liver disease	14 (10.6)
Chronic renal impairment	3 (2.27)
Malignancy	57 (43.2)
Orthopedic prostheses or cardiac devices	14/126 (11.1)
Functional status	
Dependent for daily living activities	50 (37.9)
Acquisition	
Nosocomial	52 (39.4)
Community-acquired	28 (21.2)
Health care-associated	52 (39.4)
Long-term care facility residents	15 (11.4)

Data are presented as No. (%), unless otherwise specified.

Abbreviations: CCI, Charlson comorbidity index; IQR, interquartile range; SABSI-UTS, *Staphylococcus aureus* bloodstream infection [from a] urinary tract source.

adequate treatment than those with infection from methicillin-susceptible strains (40.3% vs 76.9%; $P < .001$). Nineteen patients (14.4%) died, of whom 10 had MRSA strains and 9 had susceptible strains (10 of 54 patients [18.5%] vs 9 of 78 patients [11.5%]; $P = .261$).

Adequate source control within the first 72 hours after SABSI-UTS was achieved in 97 patients (73.5%) (Table 3). Persistent bacteremia occurred in 9 patients (6.8%). Adequate empiric antibiotic treatment and prompt source control were associated with lower persistent bacteremia, though without reaching statistical significance (4/80 [5%] vs 5/52 [9.6%]; $P = .247$; and 1/41 [2.4%] vs 1/5 [20%]; $P = .208$; respectively). No patient developed metastatic infection or endocarditis during follow-up.

The 30-day case fatality rate was lower in patients with SABSI-UTS than in those with SABSI-other (19/132 [14.4%] vs 963/4049 [23.8%]; $P = .02$). Table 4 shows the results of the univariate and multivariate analyses of factors related to the 30-day case fatality rate. In the univariate analysis, patients who died within 30 days had higher Charlson comorbidity scores, were more frequently dependent for activities of daily living, had higher Pitt scores, and presented more frequently with persistent bacteremia than surviving patients. After adjustment for age >70 years and Charlson comorbidity score >5 points, the only risk factors that remained independently associated with 30-day mortality were dependence on daily activities (aOR, 3.877; 95% CI, 1.08–13.8; $P = .037$) and persistent bacteremia (aOR, 7.88; 95% CI, 1.57–39.46; $P = .012$). Given that very few

Table 2. Urological Characteristics of Patients With SABSI-UTS

Variables ^a	Patients With SABSI-UTS (n = 132)
Urological medical records	
Urological cancer	43 (32.6)
Bladder cancer	25 (18.9)
Prostate cancer	10 (7.6)
Other tumors causing urinary obstruction	8 (6.1)
Renal or ureteral lithiasis	23 (17.4)
Neurogenic bladder	12 (9.1)
Benign prostatic hyperplasia	6 (4.5)
Renal transplant with ureteral stricture	3 (2.3)
Indwelling urinary catheters	
Urethral catheter	52 (39.4)
Nephrostomy	21 (15.9)
Ureteric stent	10 (7.6)
Ureterostomy	7 (5.3)
Urinary diversion	3 (2.3)
Suprapubic cystostomy	1 (0.8)
Urinary manipulation	
Urethral catheter change	29 (34.11)
Urinary surgical intervention	20 (23.5)
Nephrostomy	18 (21.2)
Ureteral stent change/insertion	8 (9.4)
Urinary diversion	7 (8.8)
Prostatic/renal biopsy	3 (3.5)
Time from manipulation to bacteremia	
Mean (SD), d	15.2 (20)
Median (IQR), d	9 (2–21)

Data are presented as No. (%), unless otherwise specified.

Abbreviations: IQR, interquartile range; SABSI-UTS, *Staphylococcus aureus* bloodstream infection [from a] urinary tract source.

patients with a high Pitt score survived, this variable was excluded from the multivariate analysis.

DISCUSSION

In our large cohort of well-defined cases, we found that SABSI-UTS occurs mainly in patients with severe underlying conditions, urinary tract catheterization, and/or urinary tract manipulation. Moreover, these infections were frequently caused by MRSA strains that were not covered by empirical treatment.

It was shown that SABSI-UTS was frequent in men with multiple comorbidities, urological malignancy, dependence for daily activities, and indwelling urinary catheters, consistent with previous research [12]. Urinary catheterization leads to an inflammatory response with the induction of fibrinogen release and deposition on urinary catheters [22]. In vitro and in vivo studies suggested that the interaction between *S. aureus* and fibrinogen could contribute to the development of catheter colonization [23, 24], facilitating urinary colonization and subsequent infection.

SABSI-UTS was caused more often by MRSA when compared with SABSI from other sources. This was likely to have stemmed from the higher number of cases with nosocomial or health care–related bacteremia, the high comorbidity burden, the greater dependence on daily activities, and the high proportion of patients coming from nursing homes. The high frequency of MRSA strains is a clinically relevant issue because patients with SABSI-UTS due to these strains more often received inadequate empirical treatment and had nonsignificant

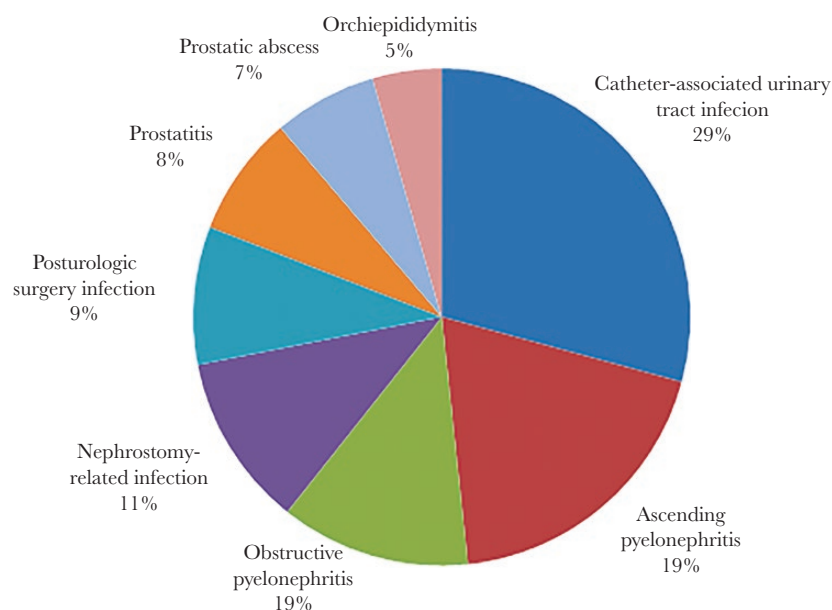


Figure 2. Diagnosis of urinary tract infection. Abbreviation: SABSI-UTS, *Staphylococcus aureus* bloodstream infection [from a] urinary tract source.

Table 3. Microbiological and Clinical Data

Variables ^a	Patients With SABSI-UTS (n = 132)
Microbiological data	
Polymicrobial bacteremia ^a	13 (9.8)
Methicillin-resistant <i>Staphylococcus aureus</i>	54 (40.9)
Clinical data	
Urinary symptoms	76 (57.6)
Pyuria	51 (38.6)
Hematuria	30 (22.7)
Fever	118 (89.4)
Baseline illness severity	
Pitt score ≥ 2	23 (17.4)
Septic shock	7 (5.3)
ICU admission	7 (5.3)
Infection management	
Source control <72 h	97 (73.5)
Adequate empiric antibiotic treatment	80 (60.6)
Echocardiography	40 (30.3)
Persistent positive urine culture	3 (2.3)
Persistent bacteremia	9 (6.8)
30-d case fatality rate	19 (14.4)

Data are presented as No. (%), unless otherwise specified.

Abbreviations: ICU, intensive care unit; SABSI-UTS, *Staphylococcus aureus* bloodstream infection [from a] urinary tract source.

^aPolymicrobial bacteremia: *Pseudomonas aeruginosa* (3, 2.3%), *Escherichia coli* (2, 1.5%), *Enterococcus faecalis* (2, 1.5%), *Enterobacter cloacae* (2, 1.5%), *Proteus mirabilis* (1, 0.75%), *Bacteroides fragilis* (1, 0.75%), *Streptococcus anginosus* (1, 0.75%), *Candida glabrata* (1, 0.75%).

but higher 30-day case fatality rates compared with patients who had SABSI-UTS caused by susceptible strains. Urinary gram staining is a rapid, easy, and cheap diagnostic method that is underused at the moment, but it could help to determine if *S. aureus* coverage is suitable (including therapy for MRSA strains) when SABSI-UTS is suspected [25]. In addition, checking for prior MRSA colonization could help when choosing the best antimicrobial treatment, particularly in patients presenting with septic shock.

The 30-day case fatality rate of 14.4% in our cohort of patients with SABSI-UTS was similar to that previously reported

[26]. Although was high, it was lower than that documented for SABSI from all sources, which was estimated to be 23.8%. We find that there were 4 main reasons for the lower mortality observed in patients with SABSI-UTS. First, the presence of urinary signs and symptoms makes the diagnosis of a urinary tract infection easier to establish, thereby triggering prompt antibiotic treatment that can offer gram-positive coverage in most cases. Second, compared with other sources of infection, SABSI-UTS was more frequently nosocomial or health care-associated, carrying a lower mortality than community-acquired infections. Third, compared with other sources of infection, septic shock was observed less frequently at presentation with SABSI-UTS [4]. Fourth, the urinary tract can be easily drained, facilitating source control and preventing persistent bacteremia. In fact, persistent bacteremia was less frequent in our cohort than in other series of overall SABSI, where data indicate rates as high as 30% of cases [27]. We therefore conclude that SABSI-UTS has a low mortality risk among sources of SABSI, as long as urinary tract infection is correctly diagnosed and asymptomatic bacteriuria secondary to SABSI from other sources has been ruled out. Nevertheless, it should be noted that the 30-day case fatality rate was higher for SABSI-UTS than was reported elsewhere for complicated urinary tract infection caused by other microorganisms (14.4 vs 8.7%; $P < .001$) [28].

In our study, the risk factors associated with 30-day mortality were a high burden of comorbidities, poor functional status, high illness severity at presentation, and persistent bacteremia. However, we did not find a statistically significant relationship between mortality and other well-described predictive factors, such as the presence of MRSA, treatment with adequate empirical antibiotics, or early source control. This could be due to the small sample size and number of deaths, which made it difficult to show statistical differences between groups.

The multicenter nature and inclusion of the largest cohort of well-defined SABSI-UTS cases are important strengths of this study, but several limitations should also be acknowledged.

Table 4. Univariate and Multivariate Analysis Related to 30-Day Case Fatality Rate

Variable	Dead Within 30 Days (n = 19)	Alive at 30 Days (n = 113)	P Value	OR	95% CI	P Value
Age >70 y	13 (68.4)	55 (48.7)	.111			
Charlson comorbidity score >5	15 (78.9)	45 (39.8)	.002			
Pitt score >2	6 (31.6)	2 (1.8)	.000			
Malignancy	10 (52.6)	45 (40.2)	.309	1.06	0.387–3.105	.863
Dependent for activities of daily living	14 (73.7)	36 (31.9)	.001	3.877	1.089–13.806	.037
Methicillin-resistant <i>Staphylococcus aureus</i>	10 (52.6)	44 (38.9)	.261	1.474	0.513–4.238	.472
Adequate empiric antibiotic treatment	13 (68.4)	67 (59.3)	.451	0.550	0.181–1.670	.291
Persistent bacteremia	4 (21.1)	5 (4.4)	.025	7.884	1.575–39.469	.012
Early source control	12 (63.2)	85 (75.2)	.270	0.641	0.215–1.911	.425

Data are presented as No. (%), unless otherwise specified. The multivariate regression was adjusted for age >70 and Charlson comorbidity score >5.

Abbreviation: OR, odds ratio.

Although patients were followed prospectively by infectious diseases specialists, and although the data were collected prospectively, the main limitation is that this was a retrospectively designed study. To overcome this, patients were selected according to clear criteria, and all cases were reviewed by a panel of infectious diseases specialists. Patients with no obvious urinary tract infection were excluded from analysis, as were patients in whom a different source of infection was possible. We also needed to exclude some patients with no urine sample for culture, and this could have led to an underestimation of the true number of episodes. Another important limitation was that few episodes of SABSI-UTS were included despite the multicenter design, and this made it difficult to carry out and interpret the multivariate analyses. This study also suffers from the lack of a comparison group. Finally, we acknowledge that, in spite of an intensive review, it is often difficult to discern the source of SABSI, so it is still possible that patients' urinary symptoms were due to high-grade SABSI from a different source.

In conclusion, SABSI-UTS occurs mostly in patients with severe underlying conditions, urinary tract catheterization, and urinary tract manipulation, consistent with existing calls to avoid unnecessary catheterization when trying to prevent urinary tract infections. SABSI-UTS caused significant mortality, and MRSA strains were identified in a large number of cases. Thus, it could be useful to perform urine gram stain and to assess previous MRSA colonization to improve empirical antibiotic treatment. In settings with MRSA prevalence comparable to (or higher than) that observed in Spain, physicians should consider MRSA coverage when deciding on the choice of empirical therapy for suspected urinary tract infection in patients with possible SABSI-UTS, particularly among those with a history of MRSA colonization.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

Acknowledgments

We thank the CERCA Programme/Generalitat de Catalunya for institutional support.

Financial support. This work was supported by Plan Nacional de I+D+i 2017–2021 and Instituto de Salud Carlos III, Subdirección General de Redes y Centros de Investigación Cooperativa, Ministerio de Economía, Industria y Competitividad, Spanish Network for Research in Infectious Diseases (REIPI RD16/0016/0005, RD16/0016/0002, RD16/0016/0001) and was co-financed by the European Development Regional Fund “A way to achieve Europe,” Operative program Intelligent Growth 2014–2020.

Potential conflicts of interest. L.E.L.C. has served as a scientific adviser for Novartis, has served as a speaker for MSD, Pfizer, Angelini, and ViiV, and has served as trainer for MSD and ViiV. J.M.A. has been a consultant to and on the speakers' bureau for Astellas Pharma, Pfizer, Gilead, Merck

Sharp and Dohme, United Medical, Biotoscana, and Roche. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

Author contributions. S.G. had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. S.G. conceived and designed the study, collected and analyzed the data, and wrote and revised the manuscript. M.L., A.L., L.E.L.C., and A.S. collected the data. G.C., I.G., J.C., and M.P. designed the study and critically reviewed the manuscript. J.M.A., L.E.L.C., and A.L. critically reviewed the manuscript. All authors have read and approved the final manuscript.

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