Telephone Consultation Cannot Replace Bedside Infectious Disease Consultation in the Management of *Staphylococcus aureus* Bacteremia

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(See the Editorial Commentary by Chu and Sexton on pages 536–8.)

Background. Infectious disease specialist (IDS) consultation improves the outcome of *Staphylococcus aureus* bacteremia (SAB). Although telephone consultations constitute a substantial part of IDS consultations, their impact on treatment outcome lacks evaluation.

Methods. We retrospectively followed 342 SAB episodes with 90-day follow-up, excluding 5 methicillin-resistant *S. aureus* SAB cases. Patients were grouped according to bedside, telephone, or no IDS consultation within the first week. Patients with fatal outcome within 3 days after onset of SAB were excluded to allow for the possibility of death occurring before IDS consultation.

Results. Seventy-two percent of patients received bedside, 18% telephone, and 10% no IDS consultation. Patients with bedside consultation were less often treated in an intensive care unit during the first 3 days compared to those with telephone consultation (odds ratio [OR], 0.53; 95% confidence interval [CI], .29–.97; $P = .037$; 21% vs 34%), with no other initial differences between these groups. Patients with bedside consultation more often had deep infection foci localized as compared to patients with telephone consultation (OR, 3.11; 95% CI, 1.74–5.57; $P < .0001$; 78% vs 53%). Patients with bedside consultation had lower mortality than patients with telephone consultation at 7 days (OR, 0.09; 95% CI, .02–.49; $P = .001$; 1% vs 8%), at 28 days (OR, 0.27; 95% CI, .11–.65; $P = .002$; 5% vs 16%) and at 90 days (OR, 0.25; 95% CI, .13–.51; $P < .0001$; 9% vs 29%). Considering all prognostic markers, 90-day mortality for telephone-consultation patients was higher (OR, 2.31; CI, 95% 1.22–4.38; $P = .01$) as compared to bedside consultation.

Conclusions. Telephone IDS consultation is inferior to bedside IDS consultation.

Keywords. *Staphylococcus aureus* bacteraemia; infectious disease specialist consultation; deep infection foci.

Staphylococcus aureus bacteremia (SAB) carries a high overall mortality rate, reported to be 7%–39% [1–3]. For SAB, infectious disease specialist (IDS) consultation provides the best evidence of improved treatment results [4–9]. Consultation by IDS is known to enhance proper antibiotic selection [4–7, 10, 11], alter therapy duration [4, 6, 8, 9], and improve outcome in bacteremia and endocarditis [1, 4–11]. Adherence to IDS recommendations from the treating physician have been shown to be of pivotal importance for disease progression and outcome [1, 10, 11]. However, the content of the IDS consultation has been defined only in a few studies [1, 8, 9] where it comprised a clinical examination, follow-up visit, and written recommendations or recommendations provided directly to the attending physician regarding appropriate SAB management [1, 9]. Only 2 studies have stated whether the IDS consultation

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was formal or informal [1, 7]. Otherwise, the formality of the IDS consultation goes unmentioned [1, 4–6, 8, 9].

An integral part of ever-deepening specialization in clinical medicine today involves informal consultations [12–16]. In these consultations, a specialist provides information, for instance, via telephone or what is called informal or curbside conversation, on disease management without meeting the patient [12]. Infectious disease specialists are among the physicians most often consulted by other specialists and general practitioners. Many of these consultations are informal [12–16], and these types of consultations may be even more frequent than formal ones [12]. Most informal consultations involving IDS are telephone-based (30%–64%) [12–14], are carried out through curbside discussion (19%) [13], or are conducted by e-mail (5%) [12]. The value of informal consultations for quality of care and outcome has been a neglected topic, however.

The objective of this study was to investigate the impact of informal IDS consultation on disease progression, outcome, and mortality regarding SAB in Finland, and to compare it to cases with formal bedside consultation or no consultation at all. Low prevalence of methicillin-resistant *S. aureus* (MRSA) enabled us to avoid the impact of differences in empirical antibiotic choice and to compare types of IDS consultation in a patient population in which each patient received appropriate antimicrobial treatment from the onset of SAB.

METHODS

Study Population

All adult patients (N = 342) with at least 1 positive blood culture for *S. aureus* from Helsinki University Central Hospital in Finland were retrospectively identified during 2000–2002 and 2006–2007. *Staphylococcus aureus* isolates and patients were matched by using the unique personal number given to all residents of Finland. Patient data came from both electronic (2006–2007) and written (2000–2002) hospital archives. For 7 patients, written documents were lacking, leading to their exclusion. Some patients from the 2000–2002 study period were included in our previous study [17]. We included 2 time periods to exclude the effect of unidentified temporary differences in treatment practices, personnel, or other factors difficult to control for. By including both electronic and paper records, the possible disadvantage with either information storage pattern was taken into account. Bacteremia due to MRSA was omitted (5 cases during 2000–2002, and no cases during 2006–2007). We followed patient records for 90 days, documenting age, sex, underlying diseases, acquisition of SAB, and antibiotic treatment. In addition, we had hospital duration, surgery, and infection-focus documentation verified by radiological, bacteriological, or pathological investigations or solely by clinical suspicion, and recorded time to defervescence (axillary temperature <37.5°C) and radiological and laboratory findings.

Definitions

The modified Duke criteria provided a definition of endocarditis [18]. Severe sepsis was defined as sepsis in combination with hypotension, hypoperfusion, or organ failure [19]. Prognosis or severity of underlying diseases provided the classifications healthy, nonfatal, or ultimately or rapidly fatal, according to McCabe and Jackson [20]. SAB was regarded as healthcare associated when the positive blood culture for *S. aureus* was obtained ≥48 hours after hospital admission, or when the patient had remained in a long-term care facility or undergone hemodialysis within the preceding 2 months. Deep infection foci included meningitis, mediastinitis, pneumonia, endocarditis, purulent arthritis, osteomyelitis, deep-seated abscess, and any foreign-body infection.

IDS consultations within 1 week after the first positive blood culture for *S. aureus* were grouped into 3 categories: no consultation, informal consultation, and formal bedside consultation.

Bedside consultation was recorded if the IDS had written comments into the patient record regarding status based on physical investigation and a careful review of patient records including advice on treatment such as length and choice of antibiotic treatment, need for radiological examination, and removal of any infected foreign device or eradication of possible infection focus. Informal telephone IDS consultation was recorded when the treating physician documented into the patient records the directives given by the IDS and the name of the IDS. When data on IDS consultation were lacking, the case was categorized as no consultation. Length of antibiotic therapy was considered proper when administered intravenously for at least 28 days for a deep infection focus and 14 days in the absence of any deep infection.

Outcome

Primary outcome was mortality rate at 28 and 90 days. Secondary outcome measures were the number of deep infection foci, time to defervescence, inadequate antibiotic therapy, duration of hospitalization, and relapse of SAB within 90 days.

Statistical Analysis

Pearson χ^2 test was used to compare categorical variables, and Student t test was used for noncategorical variables. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. Univariate factors with $P < .1$ were entered into Cox regression model (proportional hazards regression), which investigates the impact of several univariate factors upon the time (days) a fatal outcome (death) occurs. Thus, Cox regression is used to estimate factors predicting 90-day mortality. Multinomial logistic regression allowed comparison of

Table 1. Patient Characteristics, Radiological Examinations, Infection Foci, and Mortality of 342 Patients With *Staphyloccocus aureus* Bacteremia According to Type of Infectious Disease Specialist Consultation

	Bedside Consultation (n = 245)[a]	Telephone Consultation (n = 62)[a]	No Consultation (n = 35)	Bedside vs Telephone Consultation		Bedside vs No Consultation	
				OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Male sex	160 (66)	38 (61)	21 (60)	1.19 (.67–2.11)	.56	1.26 (.61–2.59)	.54
Age, y, mean ± SD	53.2 ± 17.7	54.8 ± 16.5	55.2 ± 16.6		.53		.54
Healthcare-associated bacteremia	141 (57)	31 (50)	22 (63)	1.36 (.78–2.37)	.29	0.80 (.39–1.66)	.55
Underlying disease classification[b]							
Healthy or nonfatal	174 (71)	36 (58)	17 (49)	1.77 (.99–3.15)	.05	2.59 (1.27–5.32)	.008
Ultimately or rapidly fatal	71 (29)	26 (42)	18 (51)	0.57 (.32–1.00)	.05	0.39 (.19–.79)	.008
Underlying conditions							
Diabetes	30 (12)	8 (13)	8 (23)	0.94 (.41–2.17)	.89	0.47 (.19–1.13)	.09
Coronary artery disease	47 (19)	13 (21)	10 (29)	0.89 (.45–1.78)	.75	0.59 (.27–1.32)	.19
Chronic lung disease	33 (14)	12 (19)	4 (11)	0.65 (.31–1.35)	.24	1.21 (.40–3.64)	…
Dialysis	31 (13)	6 (10)	4 (11)	1.35 (.54–3.40)	.52	1.12 (.37–3.39)	.84
Corticosteroid therapy[c]	12 (5)	3 (5)	2 (6)	1.01 (.28–3.72)	.98	0.85 (.18–3.98)	.84
Previous surgery[d]	59 (24)	14 (23)	11 (31)	1.09 (.56–2.11)	.80	0.69 (.32–1.49)	.35
Treatment-related factors							
Severe sepsis[e]	16 (7)	6 (10)	11 (31)	0.65 (.24–1.74)	.39	0.15 (.06–.37)	<.0001
ICU, within 3 d	52 (21)	21 (34)	7 (20)	0.53 (.29–.97)	.037	0.85 (.34–2.09)	.72
ICU, within 7 d	71 (29)	23 (37)	11 (31)	0.69 (.39–1.24)	.22	0.85 (.39–1.84)	.69
Hospitalization, mean days ± SD	38.7 ± 21.7	30.6 ± 23.0	24.9 ± 24.8		.014		.001
Time to defervescence, mean days ± SD	6.7 ± 9.7	12.6 ± 13.4	13.4 ± 14.7		.001		.003
Radiology[f]							
Transthoracic echocardiography	188 (77)	44 (71)	9 (26)	1.35 (.72–2.52)	.35	9.53 (4.22–21.5)	<.0001
Transesophageal echocardiography	27 (11)	2 (3)	1 (3)	3.73 (.86–16.1)	.06	4.23 (.56–32.1)	.13
Whole-body computed tomography	167 (68)	34 (55)	10 (29)	1.76 (.99–3.11)	.049	5.35 (2.45–11.7)	<.0001
Leukocyte indium-111 scintigraphy	105 (43)	8 (13)	3 (9)	5.06 (2.31–11.1)	<.0001	8.00 (2.39–26.8)	<.0001
Infection foci							
Any deep infection focus	191 (78)	33 (53)	10 (29)	3.11 (1.74–5.57)	<.0001	8.84 (4.00–19.5)	<.0001
Osteomyelitis	78 (32)	6 (10)	1 (3)	4.36 (1.80–10.6)	<.0001	15.9 (2.14– 118)	<.0001
Deep-seated abscesses	110 (45)	10 (16)	0.00	4.24 (2.06–8.72)	<.0001	…	…
Endocarditis	39 (16)	4 (7)	1 (3)	2.75 (.94–7.99)	.055	6.44 (.86–48.4)	.039
Skin or soft tissue infection	174 (71)	32 (52)	14 (40)	2.29 (1.30–4.06)	.004	3.68 (1.77–7.63)	<.0001
Proper antibiotic therapy	208 (85)	39 (63)	16 (54)	2.78 (1.28–6.05)	.008	3.96 (1.47–10.6)	.004
Mortality							
Within 3 d	1 (0.5)	1 (2)	9 (26)	0.25 (.02–4.05)	.29	0.01 (.00–.09)	<.0001
Within 7 d	2 (1)	5 (8)	9 (26)	0.09 (.02–.49)	.001	0.02 (.01–.12)	<.0001
Within 28 d	12 (5)	10 (16)	12 (34)	0.27 (.11–.65)	.002	0.09 (.04–.25)	<.0001
Within 90 d	23 (9)	18 (29)	16 (46)	0.25 (.13–.51)	<.0001	0.12 (.06–.27)	<.0001
Relapse of bacteremia	3 (1)	1 (2)	2 (6)	0.76 (.08–7.39)	.81	0.21 (.03–1.27)	.061

Data are No. (%) of patients unless otherwise specified.

Abbreviations: CI, confidence interval; ICU, intensive care unit; OR, odds ratio; SD, standard deviation.

[a] Bedside and telephone consultations received within 1 week after first positive *S. aureus* blood culture.

[b] Underlying diseases characterized according to [20].

[c] Systemic prednisone >10 mg/day or equivalent for >1 month.

[d] Any surgical procedure within 3 months before bacteremia onset.

[e] Severe sepsis at onset of bacteremia.

[f] Radiology and deep infection foci localized within 3 months.

telephone IDS and no consultation vs bedside IDS consultation using bedside consultation as the reference. Mortality rate and time to defervescence were calculated with the Kaplan-Meier method, with the log rank test used to compare the graphs. Analyses were performed using SPSS software, version 12.0 (SPSS Inc, Chicago, Illinois). All tests were 2-tailed, with $P < .05$ as significant. All analyses (except Table 1) were performed by excluding cases with a fatal outcome within 3 days after onset of SAB to allow for the possibility of death before IDS consultation.

RESULTS

Patient Characteristics

IDS consultation was given bedside in 245 (72%) cases and by telephone conversation or by some other informal manner in 62 (18%) episodes, and 35 (10%) cases were managed without consultation (Table 1). Patients with bedside or telephone IDS consultations displayed no differences regarding sex, age, nosocomial acquisition, or underlying diseases, whereas patients without IDS consultation significantly more often had severe underlying diseases ($P > .01$) (Table 1). No significant differences in the occurrence of severe sepsis appeared between bedside and telephone consultation groups, whereas patients without IDS consultation suffered from severe sepsis significantly more often than bedside IDS consultation patients ($P < .0001$; Table 1). The mean time-lapse between blood culture collection and IDS consultation was 3 days for both consultations groups (data not shown).

Antibiotic Therapy

All patients received an effective antibiotic against an *S. aureus* blood isolate starting from the day of the positive blood culture. The vast majority of patients were treated with a β-lactam antibiotic, with vancomycin used in only 3% of cases. Proper length of antibiotic therapy was more usual among patients with bedside consultation than with telephone consultation ($P = .008$) or no consultation ($P = .004$; Table 1). However, when patients who died within 3 days after SAB onset were omitted, the differences were nonsignificant (Table 2).

Clinical Management

Bedside consultation was associated with shorter duration of fever as compared to telephone ($P = .001$) or no consultation ($P = .003$; Table 1, Figure 1). This occurred also when patients with fatal outcome within 3 days after SAB onset were omitted from analysis (Table 2).

Treatment in the intensive care unit (ICU) within the first 3 days after SAB onset was significantly more common among patients receiving telephone consultation than bedside consultation ($P = .037$). However, no difference emerged between

Table 2. Outcome of 331 Patients With *Staphylococcus aureus* Bacteremia According to Mode of Infectious Disease Specialist Consultation

	Telephone Consultation (n = 61)[a]			No Consultation (n = 26)			Bedside Consultation (n = 244)[a]
	No. (%)	OR (95% CI)	*P* Value	No. (%)	OR (95% CI)	*P* Value	No. (%)
Case fatality rate							
At 28 d	9 (15)	1.16 (.19–7.09)	.08	3 (12)	0.58 (.04–7.69)	.68	11 (5)
At 90 d	17 (28)	7.09 (2.00–25.0)	.002	7 (27)	5.88 (1.03–33.3)	.046	22 (9)
Deep infection focus[b]	32 (53)	0.15 (.06–.38)	<.0001	8 (31)	0.13 (.03–.54)	.005	190 (78)
Defervescence in 7 d	23 (38)	0.12 (.05–.29)	<.0001	13 (50)	0.15 (.03–.66)	.012	176 (72)
Radiological examinations[b]							
Leukocyte indium-111 scintigraphy	8 (13)	0.27 (.09–.74)	.011	3 (12)	0.29 (.06–1.49)	.14	105 (43)
Transthoracal echocardiography	43 (71)	0.68 (.28–1.66)	.40	7 (27)	0.13 (.04–.48)	.002	187 (77)
Transesophageal echocardiography	2 (3)	0.45 (.09–2.37)	.35	1 (4)	2.34 (.22–25.0)	.48	27 (11)
Whole-body CT	34 (56)	1.04 (.43–2.51)	.93	9 (35)	0.61 (.17–2.11)	.43	167 (68)
Antibiotic therapy[c]	33 (54)	0.86 (.28–2.66)	.79	19 (73)	1.98 (.42–9.35)	.39	66 (27)
Short hospitalization[c]	29 (48)	1.29 (.45–3.69)	.64	12 (46)	1.04 (.25–4.35)	.96	65 (27)

Those with telephone and no infectious disease consultation were compared to patients with bedside consultation with an infectious disease specialist by means of multinomial logistic regression analysis. Patients who died during the first 3 days after positive blood culture were excluded (n = 1 for telephone and 1 for bedside consultation and 9 for no consultation).

Abbreviations: CI, confidence interval; CT, computed tomography; OR, odds ratio.

[a] Bedside and telephone consultations occurred within 1 week.

[b] Radiology and deep infection foci localized within 3 months.

[c] Antibiotic therapy and hospitalization <28 days.

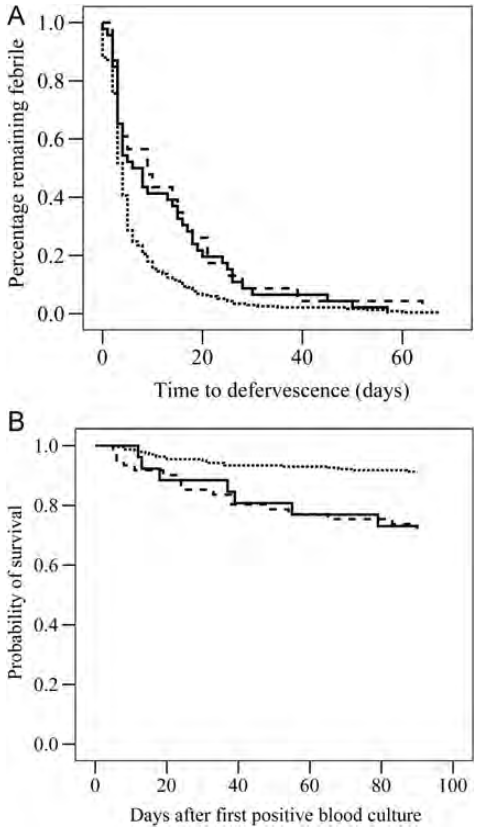

Figure 1. *A*, Kaplan-Meier analysis for time to defervescence (days) in 341 patients with *Staphylococcus aureus* bacteremia according to infectious disease specialist consultation. The dotted line represents bedside consultation within 1 week (n = 245), the solid line represents telephone consultation within 1 week (n = 62), and the dashed line represents no consultation within 1 week (n = 35). Log rank test (bedside vs telephone consultation or no consultation), $P = .001$. *B*, Kaplan-Meier analysis for 90-day survival in 331 patients with *Staphylococcus aureus* bacteremia according to type of infectious disease specialist consultation. The dotted line represents bedside consultation within 1 week (n = 245), the solid line represents telephone consultation within 1 week (n = 62), and the dashed line represents no consultation within 1 week (n = 35). Log rank test (bedside vs telephone consultation or no consultation), $P < .0001$. Patients who died during the first 3 days of bacteremia onset (n = 11) were excluded.

groups in proportions of patients with ICU treatment administered in the first week ($P = .22$; Table 1). Mean duration of hospitalization in the bedside IDS consultation group (38.7 ± 21.7 days) was significantly longer than in the telephone consultation (30.6 ± 23.0 days; $P = .014$) or no consultation groups (24.9 ± 24.8) days ($P = .001$; Table 1).

Radiological Diagnostics

No differences appeared in the use of transthoracic or transesophageal echocardiography between the telephone and bedside IDS consultation groups. Whole-body computed tomography was less frequent in the telephone IDS consultation ($P = .049$) or no consultation groups ($P = .0001$) than in the bedside IDS consultation group. Leukocyte indium-111 scintigraphy was more often received by bedside consultation patients than by the other groups ($P < .0001$; Table 1). Again, when adjusted for early (3-day) mortality, only leukocyte indium-111 scintigraphy was given significantly less often to telephone-consulted patients than to those with bedside consultation ($P = .011$; Table 2).

Infection Foci

Patients with bedside consultation more often (78%) had a deep infection focus identified than patients with telephone (53%; $P < .0001$) or with no consultation (29%; $P < .0001$), with the difference emerging in all types of foci (Table 1). As compared to bedside consultation, the OR for identifying a deep infection focus was only 0.15 (95% CI, .06–.38, $P < .0001$) in telephone consultation and 0.13 (95% CI, .03–.54, $P = .005$) if no IDS consultation was made (Table 2).

Outcome

Mortality within the first 3 days did not differ between the patients who received bedside or telephone consultation, whereas at 7 days ($P = .001$), 28 days ($P = .001$), and 90 days ($P < .0001$), mortality was significantly lower among patients with bedside consultation (Table 1). One-fourth of patients without IDS consultation had already died within the first 3 days after SAB onset and this group had higher mortality than bedside-consulted patients throughout the 90-day study period ($P < .0001$; Table 1). After excluding the deaths during the first 3 days, patients with telephone or no IDS consultation differed from bedside consultation patients in 90-day mortality but not in 28-day mortality (Table 2, Figure 1*B*).

Factors associated with fatal outcome were analyzed by the Cox regression method (Table 3). When all prognostic determinants were taken into account, telephone consultation ($P = .01$), no IDS consultation ($P = .002$), pneumonia ($P = .001$), ICU within 3 days of SAB onset ($P = .012$), and corticosteroid therapy ($P = .01$) were associated with fatal outcome in multivariate analysis. The OR for mortality for telephone-consultation patients was 2.31 (95% CI, 1.22–4.38) as compared with bedside consultation (Table 3). One hundred five (31%) patients were treated in the ICU during the first 7 days after SAB onset. Prognostic factors were analyzed separately in ICU-treated patients by comparing the fatal cases to those who survived (Table 4). Factors associated with survival were bedside consultation ($P < .0001$), McCabe healthy or nonfatal disease ($P = .003$), and whole-body computed tomography done ($P = .027$), whereas telephone ($P = .001$) or no IDS consultation ($P = .008$) and McCabe ultimately or rapidly fatal disease ($P = .003$) were associated with higher mortality in ICU-treated patients as well.

Table 3. Cox Regression Model (Proportional Hazards Regression) for Prognostic Factors of 90-Day Mortality in 331 Patients With *Staphylococcus aureus* Bacteremia

	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	*P* Value	OR (95% CI)	*P* Value
Positive prognostic impact:				
Healthy or nonfatal underlying disease[a]	0.11 (.05–.22)	<.0001	0.18 (.09–.35)	<.0001
Leukocyte indium-111 scintigraphy	0.41 (.19–.87)	.018	0.40 (.19–.87)	.021
Whole-body CT	0.43 (.23–.80)	.007	0.49 (.26–.90)	.022
Bedside IDS consultation within 1 wk	0.26 (.14–.49)	<.0001		
Transthoracic echocardiography	0.57 (.29–1.08)	.082		
Transesophageal echocardiography	0.43 (.09–1.86)	.24		
Negative prognostic impact				
Pneumonia	2.31 (1.23–4.33)	.008	2.74 (1.49–5.05)	.001
ICU within 3 d	1.96 (1.00–3.83)	.046	2.28 (1.19–4.15)	.012
Corticosteroid therapy[b]	5.48 (1.93–15.6)	<.0001	2.98 (1.29–6.85)	.01
Telephone IDS within 1 wk	3.21 (1.63–6.33)	<.0001	2.31 (1.22–4.38)	.01
No IDS consultation within 1 wk	2.51 (.99–6.37)	.045	3.56 (1.59–7.94)	.002
Ultimately or rapidly fatal disease[a]	9.24 (4.46–19.1)	<.0001		
Immunosuppressive therapy	3.00 (1.44–6.29)	.002		
Nonhematologic malignancy	3.58 (1.61–7.97)	.001		
Severe sepsis at onset of bacteremia	1.62 (.58–4.54)	.36		
Endocarditis	1.50 (.65–3.49)	.34		

Data from patients who died during the first 3 days after positive blood culture were excluded.

Abbreviations: CI, confidence interval; CT, computed tomography; ICU, intensive care unit; IDS, infectious disease specialist; OR, odds ratio.

[a] Underlying diseases characterized according to [20].

[b] Systemic prednisone >10 mg/day or equivalent for >1 month.

DISCUSSION

Our main finding was the significantly poorer outcome of SAB patients with telephone consultation as compared with bedside consultation. Patients treated by telephone consultation had >2-fold higher odds ratio of fatal outcome as compared to patients treated with bedside consultation even when the prognostic factors were adjusted for. Patients with telephone consultation also less frequently received the proper length of antibiotic treatment, and had shorter hospitalization and longer duration of fever. Radiological investigations were performed less often and fewer deep infection foci were localized in telephone consultation patients than in those with bedside consultation. A clear explanation for the poorer outcome of patients with telephone IDS did not emerge from their underlying conditions or the severity of their SAB.

SAB outcome is worse if proper antibiotic therapy is delayed [21]. MRSA is associated with both poor prognosis and delayed effective antibiotic therapy [2, 4, 22, 23]. We had no MRSA cases, and all patients had effective antibiotic therapy from the day of the first positive blood culture. The prevalence of MRSA in invasive infections in Finland has remained low, near 3% [24]. Furthermore, only 3% of our patients were treated with vancomycin, which is associated with higher persistence and recurrence of SAB than with staphylococcal penicillin cloxacillin [25]. We could, therefore, analyze the impact of IDS consultation without bias from differences in the antibiotic selection made before any IDS consultation was possible.

Retrospective analyses reflect real clinical situations but carry the possibility for many kinds of bias. Differences in patient groups have affected our results. Patients with no IDS consultation had more severe underlying diseases and more often had severe sepsis than did those with bedside consultation. This has most probably resulted in a high mortality (26%) within the first 3 days after SAB onset.

We made various attempts to control reasons for the difference in the outcome between bedside and telephone consultations. Factors associated with poor prognosis were identifiable, and several of those previously reported were also evident in our patient material, such as pneumonia [2, 26, 27], ICU treatment [6, 8], and corticosteroid therapy (>10 mg/day for >1 month) [4]. After controlling for all these factors, telephone consultation was still shown to be a significant prognostic

Table 4. Comparison of Fatalities and Surviving Patients With *Staphylococcus aureus* Bacteremia Treated in an Intensive Care Unit Within the First 7 Days of Bacteremia Onset

	Died[a] (n = 24)	Survived (n = 81)	OR (95% CI)	*P* Value
Age >60 y	9 (38)	34 (42)	0.83 (.33–2.12)	.69
Underlying diseases[b]				
Healthy or nonfatal disease	10 (42)	60 (74)	0.25 (.09–.65)	.003
Ultimately or rapidly fatal disease	14 (58)	21 (26)	4.00 (1.55–10.3)	.003
IDS consultation[b]				
Bedside[c]	7 (29)	64 (79)	0.11 (.04–.31)	<.0001
Telephone[c]	11 (46)	12 (15)	4.87 (1.77–13.4)	.001
No IDS[c]	6 (25)	5 (6)	5.07 (1.39–18.5)	.008
Radiology				
Transthoracic echocardiography	18 (75)	71 (88)	0.42 (.14–1.32)	.13
Transesophageal echocardiography	2 (8)	17 (21)	0.34 (.07–1.60)	.16
Whole-body CT	10 (42)	54 (67)	0.36 (.14–.91)	.027
Leukocyte indium-111 scintigraphy	6 (25)	29 (36)	0.59 (.21–1.67)	.32
Deep infection focus	18 (75)	63 (78)	0.86 (.29–2.48)	.86
Defervescence within 7 d	8 (33)	45 (56)	0.51 (.18–1.49)	.22

Intensive care unit treatment was given to 105 of 342 patients. Data are No. (%) unless otherwise specified. Pearson χ^2 test (*P* value) was used to compare the categorical variables.

Abbreviations: CI, confidence interval; CT, computed tomography; IDS, infectious disease specialist consultation within the first week; OR, odds ratio.

[a] Mortality during 90 days.

[b] Underlying diseases characterized according to [20].

[c] Bedside and telephone consultation or no consultation during the first week.

marker for fatal outcome, with an OR of 2.31 (95% CI, 1.22–4.38) in multivariate analysis.

ICU treatment was more common during the first 3 days among patients with telephone consultation as compared to patients with bedside consultation. This could have had an impact on higher mortality in the telephone consultation group as compared with the bedside consultation group, although no difference in ICU treatment during the first week was seen between these groups. Patients who needed ICU treatment during the first 3 days had significantly more often factors associated to higher mortality such as acute congestive heart failure (OR, 5.94; 95% CI, 2.60–13.5; $P < .000$) and severe sepsis at onset of bacteremia (OR, 10.2; 95% CI, 4.26–24.5; $P < .000$) as compared to patients without need for ICU treatment (data not shown). We attempted to control this by analyzing only patients treated in the ICU by survival rate and found that telephone consultation was one of the most important prognostic markers for fatal outcome, with an OR of 4.87 (95% CI, 1.77–13.4; $P = .001$).

IDS consultation has been reported to lead to increased localization of metastatic foci and endocarditis [1, 7–9], to improve proper antibiotic selection [4–7], and to help make antibiotic duration more appropriate [4, 6, 8, 9], with longer mean duration of therapy [5, 7]. In accordance with this, proper antibiotic therapy was more common and duration of hospitalization longer after bedside consultation. However, when adjusted for various prognostic factors in multinomial logistic regression analysis, no differences then existed in the length of proper antibiotic treatment or duration of hospitalization. We defined the proper length of antibiotic therapy based on deep infection focus localization. As telephone IDS patients were less thoroughly examined radiologically and thus had fewer deep foci localized, it is possible that among these patients, 14 days of antibiotic therapy has been interpreted as correct, although it is possible that unlocalized deep foci would have required longer therapy duration. This suggests that effective localization of deep infection foci leading to longer intravenous antibiotic therapy could be one important factor behind the better outcome for bedside consultation.

IDS consultation has been reported to result in more radiological examinations and echocardiography as well as more frequent bone scans [6–9]. In the present study, we found, somewhat surprisingly, that leukocyte indium-111 scintigraphy was an indicator of better prognosis, a finding that, to our knowledge, has not yet been reported in SAB. Indium-111 scintigraphy is not a common examination in bacteremia, but it was made to significantly more patients in the bedside consultation group as compared to the other patient groups. Therefore, the association between better prognosis and indium-111 scintigraphy needs further validation; it might be solely due to linkage to bedside consultation group.

We could link all *S. aureus* blood isolations to patient data. Records for only 7 patients were not available for analysis. Only 10% of patients were treated without any mention of IDS consultation in patient records, which ensures that the number of potentially missed telephone consultations was remarkably low. Telephone consultations during office hours were directed to the same named consultant who made the bedside consultations. Outside office hours and during weekends, telephone consultations were directed to the infectious disease specialist or resident on call. Unfortunately, we could not retrieve the time point of consultation from the patient records. This is the most likely explanation for the high proportion of telephone consultations among ICU patients and may at least in part explain the poorer outcome of telephone-consulted patients as compared to bedside-consulted patients. Insufficient information provided or important information not provided has been linked to informal or curbside consultations previously [12]. Lack of valid information for the consultant and poor adherence to advice given by him/her may be other reasons explaining the poorer outcome in telephone as compared to bedside consultation. A formal bedside consultation after every telephone consultation in SAB might be advisable.

We included 2 time periods for data collection to exclude the effect of unidentified temporary differences in treatment practices, personnel, or other factors difficult to control for. During these study periods, all patients with SAB from Helsinki University Central Hospital were included in the analyses. In addition, the 2 different study periods were considered necessary because a major percentage of patients during the first study period were included in our published trial [17]. No significant difference appeared in the results analyzed separately during the study periods (data not shown). During the second study period, we had electronic patient records, which made it possible to retrieve the patient records and laboratory results during the telephone consultation. We could not record how often electronic data were retrieved; further studies on the benefits of electronic patient records in the consultation process may be necessary.

In conclusion, our data indicate that, overall, informal or telephone IDS consultation in SAB is associated to poorer outcome compared with bedside or formal IDS consultation. Our data encourage evaluation of IDS consultation processes in SAB and suggest that it might be reasonable to complete telephone consultations by a formal bedside consultation or thorough patient record retrieval.

Notes

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