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ASSESSMENT OF CULTURING PRACTICES IN PATIENTS WITH CLINICAL SEPSIS AND DESCRIPTIVE ANALYSIS OF POSITIVE CULTURES, GEORGIA

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ABSTRACT Clinical sepsis (CS) poses a formidable challenge globally, impacting patient care and healthcare systems at large. The microbial etiology of sepsis is identified through bacteriology testing of clinical specimens. Positive culture-based targeted antimicrobial treatment improves outcomes of CS. To assess culturing practices and identify prevalent organisms associated with CS in the Country of Georgia we conducted a study of ICU patients. Eight ICUs across the country participated in the study, and 396 patients were randomly selected from the list of patients hospitalized in 2017 with PPS methodology. To identify CS episodes based on clinical parameters we used the case definition of the Surviving Sepsis Campaign. Demographic, medical and laboratory data were obtained with a structured questionnaire from the medical records. Overall 184 clinical sepsis episodes were identified in 161 (41%) patients of 396 sampled. A minimum of one clinical specimen was cultured during 72 (39%) CS episodes, and at least one positive culture was received in 56 (78%) of cultured episodes. Out of 207 clinical specimens tested 99 positive cultures were received. About half of positive cultures were gram-negative, 35% - gram-positives organisms and 10% were fungi. From 99 positive cultures, 36 were identified at the genus level and an antimicrobial susceptibility test was performed for 21 organisms. Respiratory tract specimens were most frequently tested samples (40%), followed by blood and urine specimens, respectively 25% and 23%. Out of 52 blood specimens from 45 patients 5 were culture-positive (positivity rate: 9.6%). The study showed suboptimal culturing practices in ICUs. Awareness campaigns for physicians on early recognition of CS will improve culturing practices and eventually improve CS management in ICUs.

KEYWORDS : clinical sepsis, bacteriology, positive cultures, Georgia

BACKGROUND

Clinical sepsis is a significant worldwide problem that presents a major challenge in patient care and healthcare systems. The rise in antibiotic resistance and the complexity of sepsis diagnosis and management make it essential to understand the role of bacteriology testing and positive cultures in clinical sepsis patients.

Various methods are employed for bacteriology testing in clinical sepsis patients, including blood cultures, urine cultures, and cultures of other relevant specimens such as sputum or wound swabs. The collection, processing, and interpretation of these specimens are critical for accurate pathogen identification. Moreover, the prevalence and types of organisms recovered from positive cultures in clinical sepsis patients may vary across different regions and healthcare settings.

Understanding the microbial etiology of sepsis is crucial for appropriate management and treatment decisions. Bacteriology testing plays a pivotal role in identifying the specific pathogens responsible for sepsis, enabling targeted antimicrobial therapy, and improving patient outcomes. Positive cultures provide valuable information for clinicians, guiding the selection of effective antibiotics and aiding in the assessment of treatment response.

Studies have shown that certain organisms are more frequently recovered in clinical sepsis patients. These include gram-positive bacteria such as Staphylococcus aureus and Streptococcus pneumoniae, as well as gram-negative bacteria like Escherichia coli, Klebsiella spp. and Pseudomonas aeruginosa.

Our study aimed to evaluate culturing practices and identify most prevalent organisms in positive cultures from patients with clinical sepsis in intensive care units (ICU) in the country of Georgia.

Methods

We obtained a list of ICU patients hospitalized in 2017 from 8 adult ICU across the country and randomly selected 396 patients with proportionally to size (PPS) methodology.

Clinical information was abstracted from the medical records of the sampled patients with a standardized data collection form. Abstracted data included basic demographics (sex, age, and employment status), clinical diagnosis at admission, comorbidities, clinical investigations and treatment outcomes. Data were entered and analyzed in EpiInfo version 7.

Clinical sepsis was defined as a condition of the patient with fever (>38◦C) or hypothermia (<36◦C)for >2 hours when at least two criteria from the following were presented in the window period: (1) hypotension (arterial blood pressure ≤90/60 mm Hg), or mean arterial pressure (MAP) < 60, or in vasopressors were added to the treatment course, (2) tachypnea (respiratory rate (RR) > 20 per min) or PaCO2<32mmHg, (3) Heart rate >90/per min, (4) leukocytosis (WBC >12,000μL) or leucopenia (WBC <4,000μL) or band cells >10%, (5) oliguria (urine output <0.5 ml/kg/hr or <500ml/day) or increase of retaining level (>0.5mg/dL or 44.2μmol/L) or metabolic acidosis (lactate level ≥ 2 mmol/L).

The clinic sepsis window period was defined as +/- 3 days from fever onset. Positive cultures from any clinical specimens obtained within 14 days from fever onset were considered as part of the clinical sepsis episode of investigation.

To evaluate culturing practices in ICU patients we registered obtained clinical specimens by site of origin and analyzed the positivity rate of conventional bacteriological investigations by specimen type.

Clinical specimens we divided into 4 groups by their origin: blood, urine, respiratory and others. Blood samples obtained from 2 or more different body sites at the same time are considered as one specimen. A blood specimen is considered positive when the true pathogen is recovered from at least one blood sample, and when positive cultures of the same common contaminant are received from two or more clinical samples. The respiratory specimen group consists of samples

obtained from the lower respiratory tract: sputum, endotracheal aspirates, bronchoalveolar lavage (BAL), and bronchial washing. Specimens from surgical sites, damaged skin and pressure ulcers are combined into the "other" group.

RESULTS

Overall we identified 184 clinical sepsis (CS) episodes in 161 (41%) patients out of 396 sampled. Only one CS episode was registered in 143 (89%) and two episodes in 16(10%) of these patients. Single patients had 4 and 5 CS episodes. The proportion of patients with at least one CS episode varied by hospitals from 18% to 64% (median: 42.5%). Out of 184 CS episodes 72 (39%), at least one clinical specimen was cultured. One or more positive cultures were received in 56 (78%) of cultured episodes.

Out of 161 patients with CS episodes at least one specimen for culturing was obtained from 63 (39%) patients, and at least one positive culture was received in 61 patients. The proportion of cultured patients with at least one CS episode varied by hospitals from 0% to 67% (median: 39%).

Overall 207 clinical specimens were obtained with 99 positive cultures during the study period (See Table 1: Number of clinical specimens and positive cultures by sites of origin from patients with clinical sepsis episodes).

Table 1: Number Of Clinical Specimens And Positive Cultures By Sites Of Origin From Patients With Clinical Sepsis Episodes

Specimen type	Number of tested	Number of positive cultures	Positivity rate
Blood	52	5	9,6%
Urine	47	23	48,9%
Respiratory	83	59	71,1%
Other	25	12	48,0%
Total	207	99	47,8%

Respiratory tract specimens represented 40% of all investigated clinical specimens; blood and urine were respectively 25% and 23%.

Conventional bacteriology testing of the clinical specimens was conducted in 5 clinical laboratories with different capacities. In 36 positive cultures pathogens were identified at the genus level (see Table 2: Positive cultures by site of specimen origin). Antimicrobial susceptibility testing was done for 21 of 99 recovered organisms.

About half (48.5%) of cultures were gram-negative organisms: Pseudomona spp. -12, Klebsiella spp. – 11, Acinetobacter spp. – 9 and enterobacter spp. – 9. Gram-positive organisms consisted 35.4% of all cultures. Five out of eight Staphylococcus aureus strains were MRSA. Candida albicans was the only type of fungus recovered from the clinical specimens. Two-thirds of all candida cultures (8 out of 13) were received from urine specimens.

Out of 52 blood specimens from 45 patients 5 were positive. Thus, the culture positivity rate for blood specimens in our study was 9.6%. Three out of five recovered pathogens were gram-negative: Enterobacter spp., Klebsiella spp. and Acinetobacter baumannii. Single cultures of MRSA and Candida albicans were received from blood specimens.

Overall 59 organisms were recovered from 83 respiratory specimens. More than half of the organisms were gram-negative. Klebsiella, Acinetobacter, Pseudomona and Enterobacter represented half of the positive respiratory cultures. Streptococcus Pneumoniae was the most frequently recovered gram-positive organism from respiratory specimens. We could not identify how many recovered organisms were associated with respiratory tract infection due to a lack of clinical and imaging data.

Table 2: Positive Cultures By Site Of Specimen Origin

	Organism	Blood	Respiratory tract	Urine	Other	Total
Gram (-)	Enterobacter spp	1	7	1		9
	Acinetobacter baumannii	1	7			8
	Acinetobacter spp		1			1
	Klebsiella pneumonia		3			3
	Klebsiella spp	1	7			8
	Pseudomonas aeruginosa		4	2	2	8
	Pseudomonas spp		3	1		4
	E. coli		1	2		3
	Proteus spp			1	2	3
	gr -			1		1
Gram (+)	MRSA	1	2		2	5
	Staphylococcus aureus		3			3
	Staph spp		4	1	3	8
	Streptococcus pneumoniae		6		1	7
	Enterococcus spp		5	6	1	12
	other		2		1	3
Fungi	Candida albicance	1	4	8		13
	Total	5	59	23	12	99

From 161 patients with at least on CS episode 109 (67.7%) died in hospital. Out of 109 lethal cases 51 were patients with at least one culture. Lethal outcome was 1.4 times higher in patients with at least one clinical specimen cultured (RR=1.4 95% CI 1.1 – 1.7).

DISCUSSION

Based on our data analysis, sepsis is commonly unrecognized and is associated with high mortality rate. About 41% of sampled ICU patients had at least one episode that met clinical sepsis criteria, and only 39% of them were cultured.

Blood specimen was drawn from 28% of patients with clinical sepsis episodes. Blood culture positivity rate in our sample was 9.6%. Respiratory tract specimens were cultured most frequently and consisted 40% of all clinical specimens tested. Although we couldn't link the positive cultures from respiratory tract specimens to infection due to lack of clinical information, data showed highest positivity rate (71.1%) for this group of specimens.

Gram-negative cultures were prevalent in recovered organisms; Pseudomona spp., Klebsiella spp., Acinetobacter spp. and Enterobacter spp. were presented equally though.

Two ICUs out of eight participated in the study demonstrated extremely low utilization of bacteriology testing: no clinical specimen was cultured from these ICUs. Besides that, AST was performed for 20% of the positive cultures. Higher mortality rate in cultured patients comparing to uncultured patients with at least one CS episode suggest that the testing was done for patients in critical conditions, and test results were not used properly for adjusting treatment approach, including antimicrobial course. Based on these data, we assume that access to the bacteriology laboratory is not same for all hospitals and physicians either mistrust bacteriology laboratory results, or do not utilize them.

Strengthening microbiology laboratory capacity and awareness campaigns among physicians on early

recognition of CS will improve patient clinical management and treatment outcomes for patients with CS.

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