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A breakthrough approach for rapid antimicrobial susceptibility testing in Gram-negative bloodstream infections from positive blood culture and isolates

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Background

Gram-negative bloodstream infections (GN-BSI) are severe, challenging, and life-threatening conditions. Hospital-acquired GN-BSI typically require prolonged antibiotic treatment from seven to 14 days. In this context, timely identification of the pathogen's Antimicrobial Susceptibility Testing (AST) and Minimum Inhibitory Concentration (MIC) enable a prompt, targeted therapeutic intervention, which can enhance the patient's outcome. Rapid and reliable devices have been developed to meet the need. ASTar (Q-LINEA, Uppsala, Sweden) is a fully automated device designed to perform AST from positive blood cultures, providing results completed with Antimicrobial Resistance (AMR) and MIC in less than six hours. This study evaluates the performance of the ASTar® BC G-Consumable kit.

Materials and Methods

51 positive leftover blood cultures for GN were collected at the Greater Romagna Hub Laboratory (Cesena, Italy) during the daily diagnostic routine. The samples were processed using the diagnostic reference method, the VITEK®2 (bioMérieux, Marcy-l'Étoile, France), and ASTar. The Category Agreement (CA), Minor Error (MIN), Major Error (ME), and Very Major Error (VME) were calculated based on the RIS interpretation class. Moreover, 19 additional samples were included, and isolated on Columbia agar + 5% sheep blood (bioMérieux, Marcy-l'Étoile, France) to obtain isolated colonies, which were processed using both VITEK®2 and ASTar. Results were analysed considering CA, MIN, ME, and VME.

Results

When comparing VITEK®2 and ASTar from positive blood cultures, 575 data-point were analyzed yielding 538 CA (93.57%), 20 MIN (3.48%), 6 ME (2.26%), and 4 VME (0.7%). Interestingly, in one heterogeneous case of *Klebsiella pneumoniae*-related BSI, ASTar revealed the onset of a complete resistance approximately five days before the reference method. Seven ME were reported in this sample. Considering the 19 isolated colony samples, 214 antibiotics were analyzed, resulting in 209 CA (97.66%), 3 MIN (1.40%), 1 ME, and 1 VME (0.47%, respectively). Errors distributions are reported in Table 1.

*Table 1: error distribution according to antibiotics. MIN: Minor Error; ME: Major Error; VME: Very Major Error. *: discordant results not confirmed using E-test; **: discordant results confirmed using E-test.*

Type of analysis	*Positive blood culture **			*Isolated colonies ***		
	Error type			*Error type*		
Antibiotic	**MIN**	**ME**	**VME**	**MIN**	**ME**	**VME**
Amikacin	0	1	0	0	0	0
Amoxicillin - Clavulanic acid	0	2	1	0	0	0
Cefazoline	0	1	0	0	0	0
Cefepime	4	1	0	0	0	0
Cefotaxime	2	1	0	0	0	0
Ceftazidime	4	0	0	0	1	0
Ceftazidime - Avibactam	0	1	0	0	0	0
Ciprofloxacin	4	0	0	1	0	0
Ertapenem	0	2	0	0	0	0
Gentamicin	0	1	0	0	0	0
Levofloxacin	4	0	0	1	0	0
Meropenem	1	1	0	0	0	0
Piperacillin - Tazobactam	1	2	3	1	0	1
Total	**20**	**13**	**4**	**3**	**1**	**1**

Conclusions

The ASTar device and ASTar® BC G–Consumable kit are valuable and robust methods for timely detecting GN-BSI from both positive blood culture and isolated colonies. The introduction of the system into diagnostic routine can enable an earlier detection of AMR in advance, particularly in heterogenous resistant infections.