RES-193 Gram-Positive Organisms In Pyelonephritis: Risk Factors and Empiric Therapy

Single-center, retrospective study, Japan
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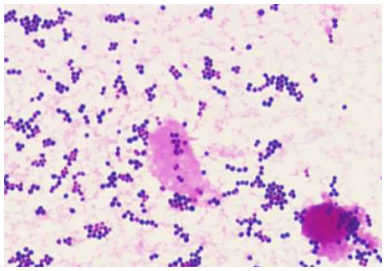
Introduction and purpose

The risk factors for pyelonephritis caused by gram-positive organisms remain poorly defined, and guidance on when empiric therapy should target these pathogens is lacking. The current guidelines for pyelonephritis recommend starting treatment with antibiotics against gram-negative rods (GNR) such as Escherichia coli, although gram-positive organisms are occasionally responsible. Previous studies have not specified conditions that require empiric antibiotic coverage against gram-positive organisms. The guidelines do not mention the utility of Gram stain of urine specimens.



Materials/methods

A single-center, retrospective study at a 358-bed community teaching hospital in Japan. Medical records were reviewed for adult inpatients diagnosed as pyelonephritis with positive blood cultures from October 2016 to December 2019. We evaluated the results of Gram stain of urine specimens, the results of urine and blood culture findings, causative organisms, the options of antibiotics as empiric therapy, and their clinical courses. All statistical analyses were performed with EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria).

Results

We extracted 241 cases of pyelonephritis (mean age 77.8 years, male 30.3%). Gram-positive cocci (GPC) and rods (GPR) were identified as causative organisms in 21 cases (8.7%, 95% CI: 5.5–13.0%)(Table 1).

Table 1. Characteristics of the 241 cases

	GPCs and GPRs	GNRs	*p*-value
	n=21	n=220	
Age	79.1	77.7	0.64
Male sex, %	13 (61.9)	60 (27.3)	0.002
Hydronephrosis, %	14 (66.7)	76 (35.5)	0.003
Urinary stone, %	10 (47.6)	39 (17.8)	0.003
Foley catheter, %	4 (19.0)	23 (10.5)	0.269
Ureteral catheter, %	3 (14.3)	4 (1.8)	0.016
Urological malignancy, %	2 (9.5)	17 (7.7)	0.675
BPH, % *	5 (23.8, 38.5)	15 (6.8, 25.0)	0.02, 0.326
Diabetes, %	4 (19.0)	49 (22.3)	1
ADL-dependent, %	10 (47.6)	87 (39.5)	0.492

* BPH: benign prostatic hyperplasia. The latter was evaluated only in male patients.

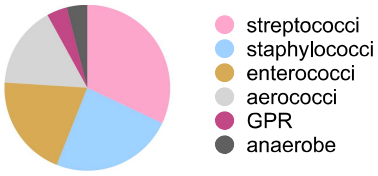


Figure 1. Gram(+) as responsible organisms

Cox regression analysis identified **male sex** (odds ratio 4.8, 95% CI: 1.60–14.4, p=0.005), and **ureteral stones** (odds ratio 3.7, 95% CI: 1.08-12.6, p=0.037) as independent predictors.
There were no statistically significant differences with respect to the presence of a ureteral catheter, a Foley catheter, or hydronephrosis.

The causative organisms included streptococci (n=8), staphylococci (n=6), enterococci (n=5), aerococci (n=4), Actinotignum schaalii (n=1), and Peptostreptococcus spp. (n=1), including the cases in which multiple organisms were responsible, specifically (Fig.1). Cefmetazole had been chosen most frequently as empiric therapy (67.3%). During empiric therapy, the gram positive cases tended to receive inappropriate antibiotics compared with the GNR cases (23.8% vs. 2.7%, odds ratio 10.1, 95% CI: 2.01–50.9, p=0.005)(Fig. 2).

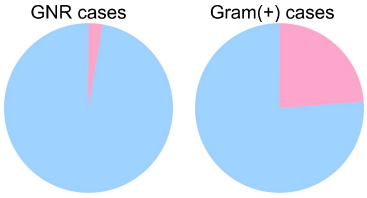
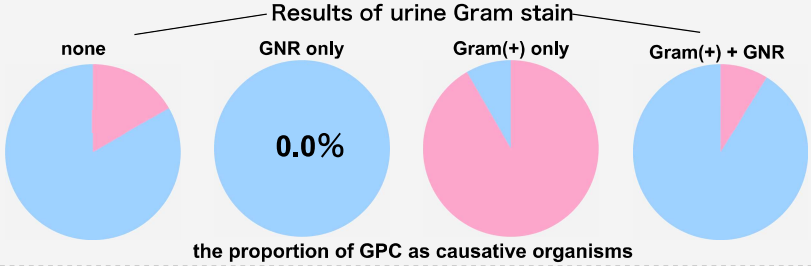


Figure 2. Resistance to empiric therapy

Figure 3. Results of urine Gram stain and cases with gram-positive organisms as causative pathogens



Of the 12 cases in which only gram-positive organisms were observed on urine Gram stain, gram-positive bacteria were identified as the sole causative pathogens in 11 cases (91.7%). Similarly, among the 121 cases with only GNR detected on Gram stain, the causative pathogens were GNR alone in all 121 cases (100%). When both gram-positive organisms and GNR were present on urine Gram stain, gram-positive bacteria were identified as causative pathogens in 9 out of 102 cases (8.8%), with 3 of these being mixed infections with GNR (Fig. 3)

Discussions

Identification of Gram-positive bacteria in urine cultures is often confounded by colonization or contamination, making accurate risk factor assessment difficult. Our study minimizes such bias by including only cases with positive blood cultures for Gram-positive pathogens, ensuring reliable attribution of causality.

In this study, only male sex and ureteral stones were identified as significant risk factors, highlighting the need for larger, multicenter investigations. Cases caused by Gram-positive bacteria showed a tenfold higher risk of empiric therapy failure compared with GNR-only cases, indicating the importance of appropriate Gram-positive coverage in high-risk patients. When a single organism is seen on urine Gram stain, it can reliably predict whether the causative pathogen is Gram-positive or Gram-negative, supporting more effective empiric therapy choices.

Limitations

Single-center, retrospective design and small number of Gram-positive cases limit generalizability.

Conclusions

Empiric therapy for pyelonephritis should consider gram-positive coverage, particularly in male patients or those with ureteral stones. Urine Gram stain can help guide this choice.

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No potential COI to disclose