Intravenous versus oral antibiotics for children treated in the Emergency Department for UTI/pyelonephritis: what are the differences in clinical characteristics and outcomes?

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Introduction

Febrile UTI/pyelonephritis is a common diagnosis in children presenting to the Emergency Department (ED). A Cochrane review of the management of pyelonephritis in children¹ suggests no difference in outcomes between intravenous (IV) and per oral (PO) antibiotics. Despite this, many children are treated with IV antibiotics for which the reasons are often unclear. Additionally, the Cochrane review was based on studies that excluded children with more severe features including vomiting^{2,3}, urological abnormality^{2,4,5}, previous UTI^{2,5}, or oral antibiotics prior to presentation^{2,4,5}. The National Centre for Clinical Excellence in the UK and the American Academy of Pediatrics guidelines do not clearly state the criteria for IV antibiotics (box 1). Our aim was to compare presenting characteristics of the children treated with IV versus PO antibiotics.

Methods

A prospective observational study of children presenting to the ED at a tertiary children's hospital in Australia with UTI/pyelonephritis from May 2016 – Nov 2017. Data collection included demographic, clinical features, microbiology, treatment and outcomes. Key features and outcomes were compared.

Results

- Of 541 children included, 378 (70%) received antibiotics PO, 143 (26%) IV and 20 (4%) intramuscular (analysed with the IV group).

Clinical features

- There was no difference in the age of the patients in each group (table 1).
- Patients were significantly more likely to receive IV antibiotics if they presented to ED with fever, vomiting, rigors or lethargy, had a history of previous UTI, or were pre-treated with PO antibiotics.
- Patients with a known history of a previous resistant organism were not more likely to receive IV antibiotics.
- A substantial number of our patients (n=390, 72%) had a urological abnormality, vomiting, previous UTI(s) or were pre-treated with oral antibiotics. These patients were excluded from the Cochrane review so lack an evidence base for their management. 250 (64%) of this group were treated with PO antibiotics alone.

Treatment

- Those treated with IV antibiotics were more likely to receive IV fluids (table 2).
- Of those treated with IV antibiotics, the majority received 1 (38%) or 2 (36%) days of IV antibiotics prior to switch to PO.
- The only apparent difference in those treated with 2-3 days versus 1 day of initial IV antibiotics is the number receiving maintenance fluids (table 3).

Outcomes

- There was no difference in the proportion of representation to ED or admission between the groups.

Conclusion

- IV antibiotics are currently used in 30% of patients with UTI/pyelonephritis.
- The IV group appears to have different characteristics from the PO group and some receive additional management with fluid therapy.
- While the patients treated with initial IV antibiotics appear different from those treated with PO antibiotics, the groups treated with an initial 1 vs 2-3 days appear to be similar.
- Recommendations for IV versus PO and duration of IV treatment of UTI need to become more evidence based.

Take Home Messages

- Shorter IV antibiotic durations than those being used in current clinical practice maybe sufficient but this requires further research.
- Despite the Cochrane review there is a lack of evidence in the most appropriate initial antibiotic route, particularly in those patients who are vomiting, have underlying urological abnormalities, have had previous UTIs, or are on prior oral antibiotics.

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Box 1

Guideline	Initial antibiotic route	IV antibiotic duration
American Academy of Pediatrics	Route of administration should be based on practical considerations. Initiating treatment orally or parenterally is equally efficacious.	The (total) duration of antimicrobial therapy should be seven to 14 days. (Duration of IV antibiotics not specified)
National Centre for Clinical Excellence (UK)	If oral antibiotics cannot be used, treat with an IV antibiotic agent	2-4 days followed by oral antibiotics for a total duration of 10 days.

Table 1: Demographics and clinical features

Initial antibiotic route	PO No. (%)	IV No. (%)	Odds Ratio [95%CI]	p value
Total patients	378 (70)	163 (30)		
Age				
Mean (+/- SD)	5.4 +/- 4.2	5.2 +/- 5.2		0.64
Age <6 months	14 (22)	19 (25)		0.66
Sex				
Female	301 (80)	116 (71)		0.02
Prior to presentation				
Urological abnormality	35 (9)	40 (23)	2.6 [1.6-4.3]	<0.001
Previous UTI	105 (30)	66 (44)	1.8 [1.2-2.7]	0.003
Prior antibiotics	71 (19)	51 (32)	2 [1.3-3.1]	0.001
Prophylaxis	11 (3)	12 (8)	2.6 [1.1-5.8]	0.023
Known resistant organism	27 (8)	18 (13)	2.6 [1.1-5.8]	0.116
Clinical features				
Fever	197 (52)	133 (81)	4.1 [2.6-6.3]	<0.001
Rigors	16 (4)	27 (17)	4.5 [2.4-8.5]	<0.001
Vomiting	130 (34)	85 (52)	2.1 [1.4-3.0]	<0.001
Lethargy	70 (19)	47 (29)	1.8 [1.2-2.7]	0.007
None of above	127 (34)	11 (7)	0.1 [0.1-0.3]	<0.001
Results				
Urine culture positive	186 (49)	120 (74)	0.3 [0.2-0.5]	<0.001

Table 2: Treatment and outcomes

Initial antibiotic route	PO No. (%)	IV No. (%)	Odds Ratio [95%CI]	p value
Total patients	378 (70)	163 (30)		
Treatment				
Fluid bolus	1 (0.3)	25 (16)	69 [12-100]	<0.001
Maintenance fluids	7 (2)	59 (37)	31 [14-68]	<0.001
Outcome				
Representation to ED	26 (7)	15 (9)	1.1 [0.5-2.0]	0.97
Readmission	8 (2)	4 (2)	0.9 [0.2-3.6]	0.89

Table 3: Comparing those treated initially with a total of 1 versus 2-3 days IV antibiotics

	1 day IV No. (%)	2-3 Days IV No. (%)	p values
Total patients	64 (39)	74 (45)	
Age			
Mean (+/- SD)	4.8 (+/- 4.8)	4.3 (+/- 4.7)	0.55
Clinical features			
Fever	52 (81)	61 (80)	0.88
Rigors	10 (16)	9 (12)	0.52
Vomiting	29 (45)	45 (59)	0.10
Lethargy	22 (34)	23(30)	0.60
None of above	6 (9)	4 (5)	0.35
Prior to presentation			
Urological abnormality	9 (15)	19 (26)	0.12
Previous UTI	22 (37)	32 (43)	0.44
Prior antibiotics	46 (73)	44 (58)	0.06
Prophylaxis	6 (10)	2 (3)	0.08
Known resistant organism	4 (7)	11 (17)	0.10
Results			
Urine culture positive	40 (63)	54 (73)	0.20
Treatment			
Fluid bolus	9 (14)	8 (11)	0.54
Maintenance fluids	13 (21)	33 (45)	0.003
Outcome			
Representation to ED	13 (20)	11 (15)	0.50
Readmission	5 (8)	3 (4)	0.47

Figure 1: Frequency of different combinations of symptoms in the PO and IV antibiotic groups

Graph 1: Choice of initial IV antibiotics

Graph 2: Choice of initial PO antibiotics

Graph 3: Choice of PO antibiotics after IV antibiotics

Graph 4: Organism Cultured in Urine in ED

Graph 5: Length of IV antibiotic treatment