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Outcomes of outpatient parenteral antimicrobial therapy (OPAT) for urinary tract infections – A single center retrospective cohort study

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ABSTRACT

Background: Outpatient parenteral antimicrobial therapy (OPAT) is widely used to safely administer intravenous antibiotics in the outpatient setting. However, there are risks of treatment failure and clinical complications. We evaluate the outcomes of episodes of urinary tract infection (UTI) treated through OPAT at a large tertiary referral center in the UK.

Methods: We retrospectively reviewed patient records of episodes of UTI treated for ≥ 2 days at the Sheffield Teaching Hospitals OPAT unit from 2017 to 2021. We defined OPAT and infection failure as unplanned 30-day hospital readmissions and symptomatic non-improvement, respectively. Univariate and multivariate logistic regression analyses were performed to analyze predictors of these outcomes.

Results: 162 episodes of UTI in 115 patients were analyzed. OPAT failure was observed in 16.0 % (n = 26) of episodes, while infection remained unresolved in 8.0 % (n = 13) of episodes. Urolithiasis was an independent risk factor of both OPAT (odds ratio [OR], 4.3; 95 % confidence interval [CI], 1.2–16.1; $p = 0.03$) and infection failure (OR, 5.9; 95 % CI, 1.2–29.9; $p = 0.03$). Prior hospitalization also increased the risk of both OPAT (OR, 4.4; 95 % CI, 1.1–18.7; $p = 0.04$) and infection failure (OR, 8.0, 95 % CI, 1.3–78.4; $p = 0.04$).

Conclusions: These results can assist clinicians at commencement of OPAT to identify patients at high risk of treatment failure. Wider network studies are required to further elicit the role of urolithiasis and its treatment to improve outcomes of UTI management in OPAT.

Introduction

Urinary tract infections (UTIs) are among the most frequent infections diagnosed in ambulatory care (Hsieh et al, 2019). Recent Global Burden of Disease data have highlighted the increasing incidence of UTIs especially among the elderly, leading to high economic burden (Zeng et al, 2022). Rising antimicrobial resistance (AMR) among uropathogens and increasing complexity of UTIs have increased the hospitalization burden from UTIs in several settings (Blunt, 2013; Simmering et al, 2017). In the UK, UTIs are the second most frequent diagnosis leading to sepsis admissions (De Oliveira et al., 2020). Reducing the economic burden of UTIs requires prevention of recurrent UTIs and reducing hospitalizations for complicated infections (Öztürk and Murt, 2020). Outpatient Parenteral Antimicrobial Therapy (OPAT) programs are effective in preventing hospitalizations by safely administering intravenous (IV) antibiotics to medically fit patients with complicated UTIs. Costs of treating complex UTIs by OPAT are estimated at 34–46 % of the cost of inpatient treatment (Dimitrova et al, 2021).

Evaluation of OPAT programs in the UK for specific infective diagnoses from 2015 to 2019 however, has revealed increasing treatment failure trends for UTIs (Gilchrist et al, 2022). Putative reasons for failures have not been analyzed in recent UK cohorts.

The purpose of this retrospective observational study was to identify factors associated with increased risk of OPAT failure in patients with UTIs treated via OPAT with a view to inform future strategies for optimal management.

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Methods

We performed a retrospective case review of episodes of UTI treated with OPAT between 2017 and 2021 at Sheffield Teaching Hospitals (STH), South Yorkshire, England, UK. The OPAT program and patient selection criteria have previously been described (Durojaiye et al, 2018). For this analysis, patients ≥ 18 years undergoing OPAT for a period of ≥ 2 days (MacKenzie et al, 2014) for treatment of UTI were included. Data were collected from the electronic hospital and laboratory databases; patient demographics, comorbidities, risk factors related to UTI recurrences (hospitalization or antibiotics in the last 6 months, known history of recurrent UTI) (Hooton et al, 1996), pre-OPAT referral characteristics (referral service, duration of treatment and antibiotic), microbiological data, OPAT antibiotic, mode of OPAT delivery, duration of therapy, and step-down oral antibiotics. Adverse events (AEs) were assigned to the vascular access or to the OPAT antibiotic regimen and recorded when deemed clinically significant by the OPAT/treating physician(s). Comorbidities were characterized as urological or non-urological. Multimorbidity was assessed using the Charlson Comorbidity Index (CCI) score. Antibiotic treatment pre-OPAT was defined as inappropriate when the cultured uropathogen was resistant or the patient had an allergic reaction to the antibiotic agent. Multi-drug resistance was defined as resistance to ≥ 2 classes of antimicrobials.

Treatment outcomes were defined using the British Society for Antimicrobial Chemotherapy (BSAC) National Outcomes Registry System (NORS) parameters (BSAC, 2018) and grouped into OPAT and infection outcomes. OPAT outcomes were defined as (i) success: completion of OPAT antibiotic as planned with no change in antibiotic, no AEs, symptomatic improvement, and no readmission 30 days post-OPAT discharge; or (ii) partial success: completion with either change in antibiotic or development of an AE not requiring admission; or (iii) indeterminate: readmission due to an unrelated event; or (iv) failure: readmission during OPAT or in the 30-day period post-OPAT due to worsening of UTI (as determined by OPAT clinicians) or an OPAT AE, or death during OPAT from any cause. Infection outcomes were defined as: (i) cure or improvement: completion of OPAT treatment as planned ± oral stepdown with symptomatic resolution of infection; or (ii) failure: progression or nonresponse of infection requiring admission, surgical intervention, or death for any reason. Cure and improved outcomes were not distinguishable from available medical records as patients with UTI are often discharged with continued need for further follow ups with other services and prescribed long-term antibiotic treatment upon follow-up. Economic outcome was defined as the number of bed days saved as being equivalent to the number of days of IV antibiotics administered in OPAT (Allen et al, 2021).

Anonymized patient data were collated in MS Excel® (Microsoft 365 MSO) and analyzed using Prism version 9.0 (GraphPad Software, LLC, San Diego, CA).

Baseline patient characteristics were analyzed for first OPAT episodes and compared between men and women to describe chance bias due to gender differences. OPAT and microbiological characteristics were analyzed for all (first and recurrent) OPAT episodes.

All (first and recurrent) episodes were included for outcome analyses. OPAT outcomes of success, indeterminate status or partial success were combined into one non-failure outcome. Logistic regression was performed to determine the effect (odds ratios [ORs], p-values) of presence of categorical predictor variables (for example, presence of upper UTI, bacteremia, or other comorbidities), or each unit increase in quantitative predictor variables, on failure outcomes. After univariate analysis, candidate variables were subjected to forward selection and added to the multiple regression model if the p-value exceeded 0.2 (Bursac et al, 2008). Variables showing perfect separation on univariate regression were analyzed using the analogous Fisher's exact test but removed from the multivariate model if inclusion led to model instability. In the final model, two-sided p-value of < 0.05 was considered significant.

The study was approved by the local clinical effectiveness unit as part of ongoing commitment to service development. Ethical consent was not required.

Results

Study cohort and episode characteristics

Between 2017 and 2021, 162 episodes fulfilled the inclusion criteria and were included in the analysis. Supplementary Fig. 1 presents the study flow diagram. These episodes comprised 115 patients with both first episodes within the study duration, and recurrent episodes (n = 47). Recurrent episodes were observed in 23 patients, who each experienced a mean of 3 ± 0.5 episodes during the study period.

Patients had a median age of 63 years (interquartile range [IQR], 47–76), and median CCI score of 3 (IQR, 1–6). Other patient characteristics, comorbidities and UTI risk factors are presented in Table 1. Female patients were younger, had fewer comorbidities, and were more likely to have received antibiotic prophylaxis prior to their OPAT episode.

OPAT was delivered by district nurses, and via midline IV access for the majority of episodes, over a median duration of 12 days (Table 2).

Table 1
Characteristics of 115 patients entering STH OPAT from 2017 to 2021 at first episodes.

Characteristics	*All patients*	*Male*	*Female*	*p value*††
Total, n(%)	115 (100)	51 (44.3)	64 (55.7)	
Age in years - median, (95 %CI)	63 (57–68)	68 (72–63)	52.5 (48–65)	**0.007***
Menopausal, n(%)			31 (48.4)	
Concomitant pregnancy			1 (1.6)	
Peripartum			1 (1.6)	
Non-urological comorbidities, n(%)				
Immunosuppression	28 (24.4)	12 (23.5)	16 (25)	>0.99
Diabetes	34 (29.6)	20 (39.2)	14 (21.9)	0.06
Hypertension	43 (37.4)	23 (45.1)	20 (31.3)	0.17
Chronic kidney disease	30 (26.1)	12 (23.5)	18 (28.1)	0.67
Non-urological malignancy	8 (7)	3 (5.9)	5 (7.8)	>0.99
Charlson Comorbidity Index score - median, (95 %CI)	3 (3–4)	4 (3–5)	3 (1–4)	**0.01***
Urological comorbidities, n(%)				
Renal transplant	13 (11.3)	6 (11.8)	7 (10.9)	>0.99
Urinary catheter	22 (19.1)	11 (21.6)	11 (17.2)	0.63
Intermittent self-catheterization	11 (9.6)	6 (11.8)	7 (10.9)	>0.99
Neurogenic/ overactive bladder	15 (13)	6 (11.8)	9 (14.1)	0.78
Urolithiasis	13 (11.3)	6 (11.8)	7 (10.9)	>0.99
Urogenital tumor	12 (10.4)	9 (17.6)	3 (4.7)	**0.03***
Anatomical abnormality of the urinary tract†	17 (14.8)	10 (19.6)	7 (10.9)	0.29
Known recurrent UTI, n(%)	61 (53)	22 (43.1)	39 (60.9)	0.06
Pre-OPAT use of antibiotic prophylaxis to prevent UTIs, n (%)	34 (29.6)	9 (17.6)	25 (39.1)	**0.01***

†**Included urinary strictures, polycystic, duplex, or malrotated kidneys, bladder diverticula, and Fowler's syndrome due to anatomical defect**.
*Statistically **significant**.

Table 2
Characteristics of 162 OPAT episodes of urinary tract infections and comparison between first and recurrent episodes.

Variables	*All episodes*	*First OPAT episodes*	*Recurrent OPAT episodes*	*p value*††
Number (%)	162 (100)	115 (7)	47 (29)	
Duration, days - median (95 %CI) Range (days)	12 (10–14) 2–58	10 (8–12) 2–58	14 (14–16) 3–46	**0.0029***
OPAT delivery modality, n(%)†				
Infusion center	66 (40.7)	48 (41.7)	18 (38.3)	0.72
District Nurse	78 (48.2)	58 (50.5)	20 (42.6)	0.39
Self-administered	18 (11.1)	9 (7.8)	9 (19.1)	0.0525
Venous access, n(%)†				
Peripheral	22 (13.6)	19 (16.5)	3 (6.4)	0.12
Midline	99 (61.1)	72 (62.)	27 (57.4)	0.59
Peripherally inserted central catheter	40 (24.7)	23 (20)	17 (36.2)	**0.04***
Hickman	1 (0.6)	1 (0.9)	0	
Pyelonephritis, n(%)	74 (45.7)	48 (41.7)	26 (55.3)	0.12
Culture-guided treatment, n(%)	147 (90.7)	105 (91.3)	42 (89.4)	0.76
E.coli UTI	71 (48.3)	56 (53.3)	15 (31.9)	0.06
Bacteremic UTI	22 (13.6)	17 (14.8)	5 (10.6)	0.62
Multi-drug resistant pathogenˆ	86 (53.1)	61 (53)	25 (53.2)	>0.99
Inpatient referral, n(%)	77 (47.5)	59 (51.3)	18 (38.3)	0.17
Pre-OPAT hospitalization, days – median (95 %CI)	6 (5–8)	7 (5–8)	4 (2–8)	**0.02***
Parenteral antibiotic, n (%)†				
Penicillins	16 (9.9)	12 (10.4)	4 (8.5)	>0.99
Temocillin	9 (56.2)	7 (58.4)	2 (50)	
Flucloxacillin	2 (12.5)	1 (8.3)	1 (25)	
Piperacillin-tazobactam	5 (31.3)	4 (33.3)	1 (25)	
Cephalosporin	29 (17.9)	22 (19.1)	7 (14.9)	0.65
Ceftriaxone	14 (63.6)	2 (28.6)		
Ceftazidime	16 (55.2)	8 (36.4)	3 42.8)	
Ceftolozane-tazobactam	11 (37.9)	0	2 (28.6)	
	2 (6.9)			
Carbapenem	106 (65.4)	72 (62.6 %)	34 (72.4 %)	0.27
Ertapenem	100 (84.3)	72 (100)	28 (82.4)	
Meropenem	6 (5.7)	0	6 (17.6)	
Monobactam (aztreonam)	2 (1.2)	2 (1.7)	0	
Aminoglycoside (gentamicin)	1 (0.6)	1 (0.9)	0	
Glycopeptide (teicoplanin)	5 (3.1)	4 (3.6)	1 (2.1)	>0.99
Lipopeptide (daptomycin)	3 (1.9)	2 (1.7)	1 (2.1)	>0.99
Frequency of oral stepdownε, n(%)	11 (6.8)	7 (6.1)	4 (8.5)	0.73
Oral stepdown period, days -median (95 % CI)	7 (7–28)	7 (4–90)	10.5 (7–14)	0.89

†**Option used for > 2/3rd of duration.**
ˆ**resistant to > 2 classes of antimicrobials.**
ε **Antibiotics used were amoxicillin-clavulanate (n = 3), nitrofurantoin/ pivmecillinam (n = 2 each), and ciprofloxacin/ fosfomycin/ doxycycline/ trimethoprim (n = 1 each).**
*Statistically **significant.**
††**Chi-square/ Fisher's exact test or Mann-Whitney *U* test as appropriate.**

Pyelonephritis was diagnosed in 47.5 % of episodes (n = 74) and treatment was guided by microbiological diagnoses in 90.7 % of episodes (n = 147). A positive urine culture guided diagnosis and treatment in 92.5 % (n = 136) of these episodes. Supplementary Fig. 2 shows samples used for diagnosis of UTI in the cohort. Of 147 culture-positive episodes, 139 (94.6 %) were monomicrobial, while 8 (5.4 %) were polymicrobial. *Escherichia coli* was the most frequently isolated uropathogen (48.3 %, 71/147 episodes) and remained the most prevalent pathogen in recurrent episodes. Supplementary figure 3 shows pathogen distribution in first vs recurrent UTI episodes.

Ertapenem was the most frequently prescribed OPAT antibiotic (n = 100, 61.7 %). Patients were referred from inpatient services in 47.5 % of episodes (n = 77). Recurrent OPAT episodes of UTI required significantly longer antibiotic courses and were more likely to involve central IV access (Table 2).

Adverse events and NORS outcomes

Distribution of vascular access and antibiotic related AEs by IV access and antibiotic are presented in Fig. 1. AEs occurred in 29 (17.9 %) of 162 episodes. The vascular access and antibiotic AE rates were 6 and 6.4 per 1000 OPAT patient-days, respectively. No significant differences were observed in the frequency of all AEs between first and recurrent episodes of UTI ($p = 0.82$), or vascular access complications between OPAT administered at the infusion center, via district nurses, or by patients at home ($p = 0.37$). There was no significant difference in the rates of AEs among penicillins, cephalosporins or carbapenems ($p = 0.38$).

OPAT outcomes: A successful outcome was recorded for 66 % (n = 107) of episodes, while partial success was recorded for 13.6 % (n = 22) of episodes (Fig. 2A). Outcome was indeterminate in 4.3 % of episodes (n = 7). Unplanned readmissions due to UTI or OPAT-related AEs leading to OPAT failure were documented in 16.1 % (n = 26) of episodes. No deaths were observed during OPAT treatment. However, one patient died during an unrelated admission (indeterminate outcome).

Infection outcomes: Symptomatic improvement on completion of OPAT treatment was documented in 92 % (n = 142) episodes (Fig. 2B). Patients failed to improve symptomatically, worsened, or required surgery, leading to infection failure in 8 % (n = 13) of all episodes.

Treatment of these UTI cases via OPAT saved the hospital 2487 bed-days with the associated inpatient costs (one hospital bed day is approximately £400).

Predictors of failure

Table 3 shows results of univariate and multivariate regression analyses. Predictors of both OPAT and infection failure on multivariate analysis were urolithiasis (OR, 4.3; 95 % confidence interval [CI], 1.2–16.1; $p = 0.03$ for OPAT failure and OR, 5.9; 95 % CI, 1.2–29.9; $p = 0.03$ for infection failure) and inpatient referral (OR, 4.4; 95 % CI

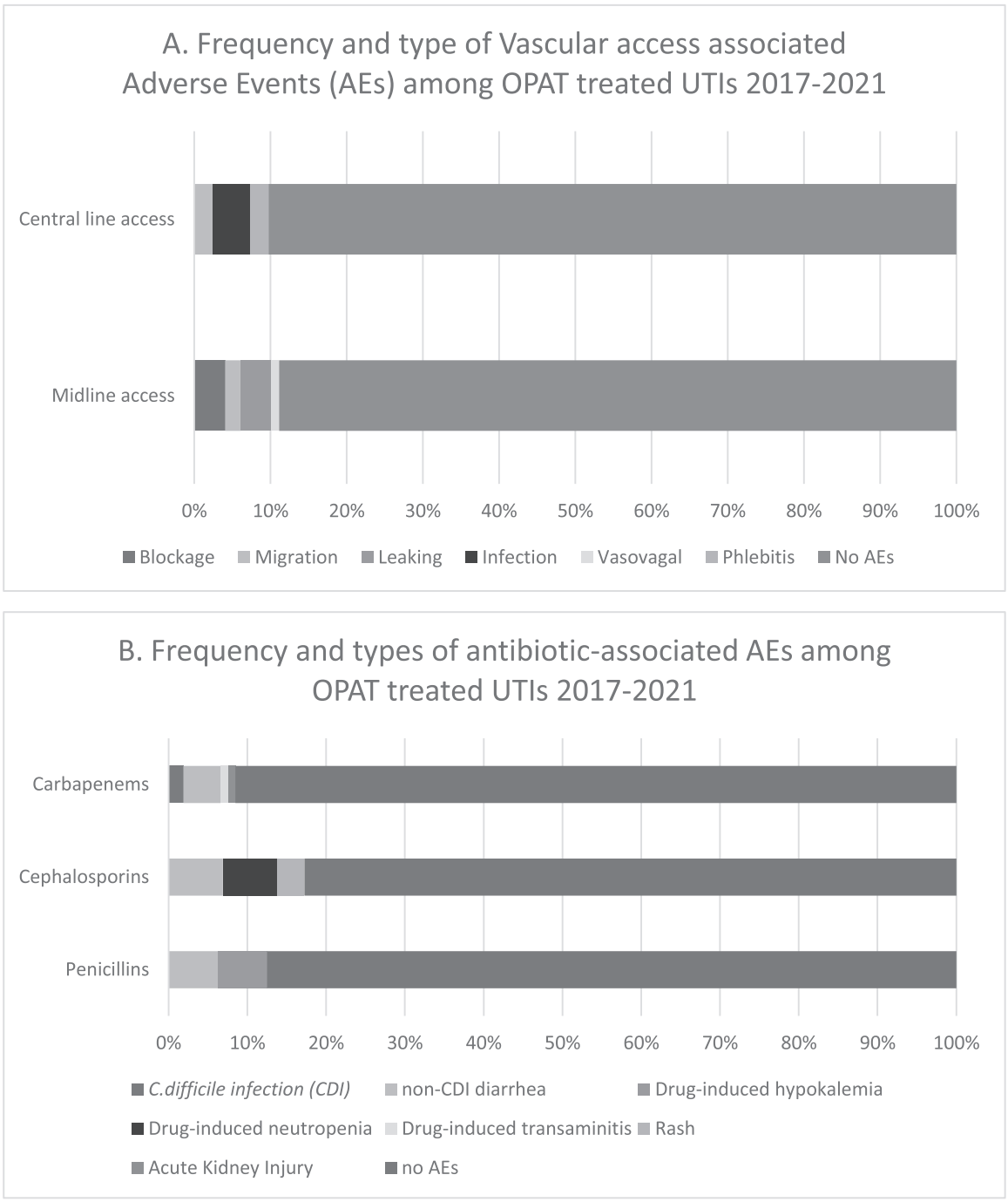

Fig. 1. Frequency and types of adverse events (AEs) in OPAT-managed UTIs 2017–2021. **A)** Vascular access related AEs, and **B)** Antibiotic-related AEs.

1.1–18.7, $p = 0.04$ and OR 8, 95 % CI 1.3–78.4, $p = 0.04$ infection failure).

Presence of a history of recurrent UTIs showed perfect separation with infection failure on logistic regression and infinite univariate odds of infection failure on correlation analysis (OR, infinity; 95 % CI, 1.9-infinity; $p = 0.004$). However, the independent effect on infection failure could not be analyzed in the multivariate model owing to model instability.

Discussion

We found urolithiasis and referral from inpatient care to be independent predictors of OPAT and infection failures for UTIs. Urolithiasis is an independent risk factor for sepsis and AKI among adults with UTIs (Yongzhi et al, 2018; Hsaio et al., 2019). The unplanned readmissions among patients with urolithiasis in our cohort were also likely to be due to worsening infection. Poor outcomes among OPAT cohorts with UTI might therefore potentially be averted through implementation of management strategies for urolithiasis; international guidelines recommend dissolution or surgical removal of symptomatic stones >10 mm, with UTI being one of the indications for active stone removal (Skolarikos et al, 2022; Assimos et al, 2016). Recent observational data have further shown that routine ureteroscopic removal of small urinary calculi improves UTI symptoms (Schembri et al, 2020). Given that untreated UTI is a relative contraindication for ureteroscopy (Wason et al, 2022), interventional studies are needed to determine optimal

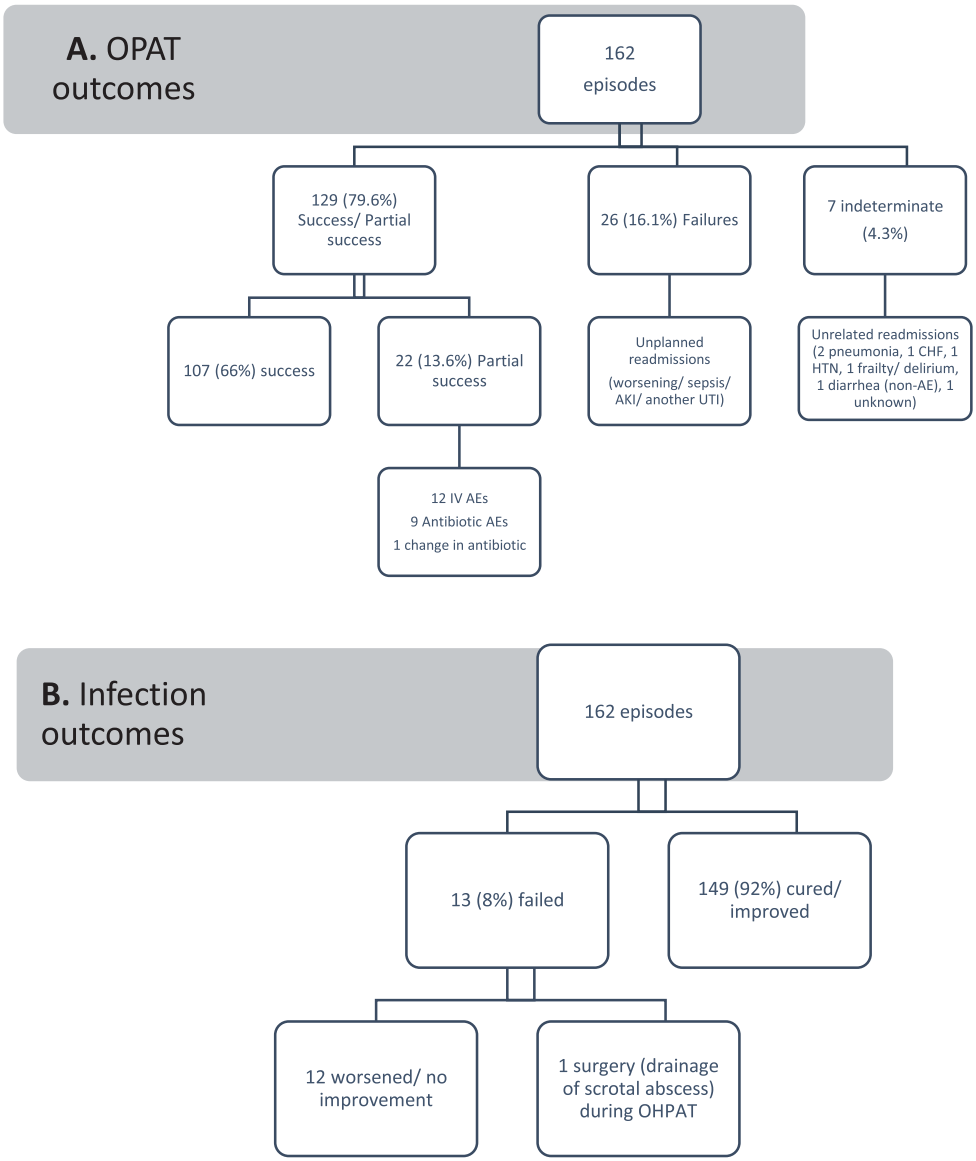

Fig. 2. Outcomes of UTI managed in OPAT; **A)** OPAT program outcomes; **B)** Infection outcomes. AKI = acute kidney injury, CHF = congestive heart failure, HTN = hypertension.

techniques and timing of stone removal in outpatients with UTI. Antibiotic use has also recently emerged as a risk factor for urolithiasis (Tasian et al, 2018; Ferraro et al, 2019). In populations with recurrent UTIs this can become problematic establishing a vicious cycle of antibiotic use and urolithaisis (Hsaio et al., 2019). Our results also suggest that a history of recurrent UTIs predisposes to infection failure in OPAT, as diagnosis of recurrent UTIs was highly coincident with treatment failures. As both antibiotic use and UTI are prolithogenic, prevention strategies for recurrent UTIs that do not increase the risk for urolithiasis, such as vaccines (Prattley et al, 2020), could have significant impact on improving UTI outcomes in OPAT. Further studies are required to assess the impact of recurrent UTIs and vaccines on both urolithiasis and OPAT outcomes.

Hospitalization immediately prior to OPAT treatment (i.e., inpatient referral) also increased the odds of both OPAT and infection failure. This effect was independent of age, CCI scores, and prior hospitalizations which have been identified as predictors of readmissions in various prediction models (Allison et al, 2014; Durojaiye et al, 2019). Other factors such as bacteremic UTI and pyelonephritis also did not affect the outcomes in this analysis. No risk prediction models are currently recommended to guide patient selection for OPAT treatment (Chapman et al, 2019). Various risk prediction models for OPAT patients with multiple infective diagnoses have demonstrated only moderate discriminative ability (Allison et al, 2014; Durojaiye et al, 2021). Since prediction model performance varies by patient population and primary diagnoses (Zhou et al, 2016; Artetxe et al, 2018), development of UTI-specific scores might more reliably identify patients at high risk of OPAT failure.

Our cohort also had 3–4 times higher rates of vascular access and antibiotic AEs compared to those reported among pediatric and adult OPAT cohorts in the UK (Gilchrist et al, 2022). However, these are aggregate rates from a number of different services and infections, with varying lengths of OPAT. Higher antibiotic and vascular access AEs have been reported among older OPAT populations (Shrestha et al, 2020). While the older age group of the population may have predisposed patients to developing AEs in our cohort, root-cause analysis and identification of systematic errors for process improvement should be advocated (Gilchrist et al, 2008).

Our study has limitations. The retrospective design precluded inclusion of variables (e.g., smoking, physical activity) that might affect

Table 3
Predictors of OPAT failure (30-day unplanned readmissions), and infection failure (symptom non-resolution) in 162 OPAT UTI episodes at STH, 2017–2021.

PREDICTOR		OPAT FAILURE				INFECTION FAILURE			
		UNIVARIATE ODDS RATIO (95 % CI)	p VALUE	MULTIVARIATE ODDS RATIO (95 % CI)	p VALUE	UNIVARIATE ODDS RATIO (95 % CI)	p VALUE	MULTIVARIATE ODDS RATIO (95 % CI)	p VALUE
Age†		2.0 (0.5–8.85)	0.0017	0.96 (0.92–1.0)	0.13	0.96 (0.92–0.99)	0.032	0.99 (0.92–1.1)	0.76
Male Sex		1.4 (0.6–3.4)	0.48			1.6 (0.5–6.1)	0.44		
Non-urological comorbidities	-Diabetes	1.6 (0.6–3.8)	0.31			0.5 (0.07–1.9)	0.35		
	-Immunosuppression	1.5 (0.6–3.6)	0.36			2.1 (0.6–6.5)	0.22		
	-CCI score†	0.8 (0.7–0.99)	0.0514	1.1 (0.8–1.4)	0.72	0.8 (0.6–1.0)	0.12	0.86 (0.5–1.4)	0.56
	-Chronic kidney disease	1.2 (0.5–2.9)	0.71			2.4 (0.7–7.7)	0.13	3.3 (0.6–19.2)	0.16
Urological comorbidities	-Anatomical defect	1.2 (0.5–3.1)	0.64			0.9 (0.2–3.4)	0.97		
	-Functional defect	1.1 (0.4–2.7)	0.90			1.6 (0.4–5.3)	0.44		
	-Catheter	2.6 (1.1–6.5)	0.0339	0.8 (0.2–2.8)	0.73	6.9 (2.2–24.4)	0.0015	3.2 (0.7–15.3)	0.13
	-Renal transplant	1.4 (0.4–3.8)	0.55			0 (0.0–1.642)	0.22		
	-Urolithiasis	4.7 (1.8–12.1)	0.0014	4.3 (1.2–16.1)	**0.03***	11.6 (3.5–42.4)	<0.0001	5.9 (1.2–29.9)	**0.03***
	-Urological malignancy	1.1 (0.2–3.8)	0.84			0.7 (0.03–3.9)	0.73		
Inpatient referral		6 (2.3–18.8)	0.0007	4.4 (1.1–18.7)	**0.04***	6.9 (1.8–45.7)	0.0139	8 (1.3–78.4)	**0.04***
Duration of hospitalization pre-OPAT (days) †		1.04 (0.98–1.1)	0.11	0.97 (0.9–1)	0.42	1.06 (0.99–1.1)	0.0653	0.97 (0.87–1.1)	0.52
Duration of OPAT (days)†		1.0 (0.9–1.0)	0.94			0.99 (0.94–1.04)	0.97		
Pathogen	non-*E.coli*††	1.4 (0.6–3.5)	0.5			1.3 (0.3–5.2)	0.71		
Resistant pathogen**		0.7 (0.3–1.8)	0.5			0.5 (0.1–1.6)	0.22		
Upper UTI		2.2 (0.9–5.2)	0.08	0.8 (0.2–2.6)	0.72	1.4 (0.5–4.6)	0.53		
Bacteremic UTI		1.6 (0.5–4.7)	0.37			1.2 (0.2–4.7)	0.85		
CRP at OPAT initiation†		1.011 (1.003–1.019)	0.0065	1.009 (1–1.02)	0.06	1.0 (0.99–1.01)	0.48		
TLC at OPAT initiation†		0.9 (0.8–1.1)	0.94			1.0 (0.89–1.2)	0.47		
Hospitalization last 6 months		3.1 (1.3–7.6)	0.0129	2.2 (0.7–6.6)	0.16	3.3 (1.0–12.8)	0.0533	1.2 (0.3–5.4)	0.84
Known recurrent UTI		1.9 (0.8–5.6)	0.18	1.7 (0.6–5.9)	0.35	Infinity (1.9-Infinity) ‡	**0.004***		
Days inappropriate antibiotic received before OPAT†		0.9 (0.8–1.1)	0.76			1.0 (0.8–1.2)	0.60		
Recurrent OPAT episode		1.4 (0.5–3.3)	0.49			1.6 (0.5–5.1)	0.43		

CCI = Charlson Comorbidity Index, CRP = C-reactive protein (mg/L), TLC = total leukocyte count (cellsx10^9/L).
†For quantitative variables, results reflect association of failure per 1 unit increase in the independent variable.
††Polymicrobial infections with both *E.coli* and a non-*E.coli* pathogen were considered non-*E.coli* UTIs.
‡Analyzed using Fisher's exact test as simple logistic regression yielded perfect separation with no possible prediction. Removed from final model due to model instability.
**Resistant pathogen = ESBL/AmpC Enterobacteriales, *P.aeruginosa* resistant to ≥ 2 antimicrobial classes and vancomycin-resistant Enterococci.
*Statistically significant.

poor outcomes (Burgio et al, 2013). We used the univariate analysis and p-value thresholds of 0.2 as an initial selection step to determine predictors in the multivariate model, which may have resulted in systematic exclusion of some important variables (Wang et al, 2017); however low odds of failure in univariate analysis also strengthen the reliability of this design. The small absolute number of infection failure events also precluded analysis with a full multivariate model. Expansion of data and time frames to allow inclusion of more failure events might increase confidence in future studies. Additionally, results from this single center cohort may not be applicable to other OPAT services due to variations in practice.

Conclusions

OPAT and infection outcomes for UTI were poorer in patients with urolithiasis and those hospitalized immediately before OPAT treatment in this cohort. Consideration should be given to additional interventions for patients with urolithaisis. More work is required to understand the specific predictors that drive poor outcome among inpatients. A wider network evaluation of OPAT services for UTI treatment are necessary to establish if there are other modifiable predictors of poor outcomes.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clinpr.2022.100212.

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