Self-Administered Outpatient Parenteral Antimicrobial Therapy for Urinary Tract Infection from the Emergency Department: A Safe and Effective Strategy to Avoid Hospital Admission

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Abstract

Aim: To determine the safety and efficacy of self-administered outpatient parenteral antibiotic treatment (S-OPAT) within a hospitalization-at-home (HaH) program to manage a urinary tract infection (UTI) in patients referred directly from a hospital ED.

Materials and Methods: This was a retrospective study of UTI episodes in patients treated initially in the ED, who were subsequently enrolled in a HaH program to receive S-OPAT. Epidemiological, clinical, and microbiological data were recorded. Safety was evaluated by means of mortality and the occurrence of unexpected hospital returns (reason, intra-hospital death) during the domiciliary period. The efficacy was evaluated considering the healing rate and analysis of mortality and repeat hospital admissions because of the UTI recurrence during the first month after discharge.

Results: A total of 268 episodes of UTI were analyzed; the mean age of patients was 59.3 years, and 53% were female. The Charlson index was 1.97. The most common types of UTI were acute pyelonephritis and urosepsis. In 61.4% of urine cultures, microbiological documentation was obtained. E. coli was the most commonly isolated microorganism. A total of 27 strains of multidrug resistant microorganisms (MRD) were recorded. The most commonly used antimicrobial drug was ceftriaxone. There was one reported death. Clinical complications that resulted in returning to hospital occurred in 3.4% of cases. The healing rate was 96.5%. During the month after discharge, 4.4% of patients required repeat admission because of the UTI recurrence.

Conclusion: S-OPAT within a HaH program in patients with UTI who are referred directly from ED is safe and effective.

Keywords: Complications, hospital at home, self-administered outpatient parenteral antimicrobial therapy, urinary tract infections

Introduction

Urinary tract infection (UTI) is one of the most commonly treated pathologies in hospital emergency departments (EDs). UTIs comprise approximately 22% of all infectious processes and are a common reason for hospital admission (1). The growing prevalence of multidrug resistant microorganisms (MRM) as a cause of UTI and other infections currently entails a severe public health problem (2). The consumption of resources arising from the treatment of UTI is very high, and in the United States alone, it is responsible

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for approximately 100,00 hospital admissions out of more than 1 million visits to EDs and a cost of more than US$1 billion (3). All these circumstances make UTI a complex clinical entity and a challenge for health care professionals.

However, alternative care systems that avoid the patient admission into a conventional hospital ward should mean improved efficiency. In this sense, some models denominated the outpatient parenteral antimicrobial therapy (OPAT), which is based on the administration of parenteral antibiotics at home, have obtained excellent results in terms of safety and efficacy in the context of clinically stable infectious processes (4). Among them, there is a variant known as self-administered OPAT (S-OPAT) in which health care staff trains carers or the patient to administer parenteral medication, which raises the efficiency even more, given that the costs arising from nursing visits are vastly reduced (5).

Moreover, in Spain, there are hospitalization-at-home (HaH) units, a more complex alternative care resource than OPAT, which offer a diagnostic and therapeutic support at home similar to the one provided on the ward and can treat any clinical process with hospital admission criteria. In these units, not only antimicrobials are administered parenterally but also other drugs are administered intravenously. Serum therapy, prior oxygen therapy, analgesics, antipyretics, and nebulized medications can be administered, blood derivatives are transfused, and all kinds of biological samples can be collected at home (6).

The primary objective of our study is to determine the safety and efficacy of UTI treatment by means of an S-OPAT regimen supported within the scope of a HaH program in patients referred directly from ED.

Materials and Methods

Study design

This was a retrospective, observational study of a series of patients. The study was approved by the Ethics Committee of the Autonomous Community of Cantabria (2017.249).

Study context and population

In Marqués de Valdecilla University Hospital, a third level hospital with an approximate capacity of 900 beds, all episodes of patients diagnosed with UTI with hospital admission criteria according to the European Association of Urology, (7) who received S-OPAT in the HaH unit immediately after being treated in the ED during a two-year period (2015-2016) were analyzed.

Data collection

Epidemiological (sex, age), clinical (comorbidity, nephrourological history, the type of UTI, the type of antibiotic, S-OPAT duration), and microbiological study variables were obtained from the clinical history records (on paper and/or electronic) of the hospital and were included in a Microsoft Excel-like database.

Objectives

The objectives were to determine safety (domiciliary mortality, complications that obliged an unexpected return to hospital, and subsequent intra-hospital death) and efficacy (healing rate, recurrence of the UTI) of this care modality.

Statistical analysis

Variables were analyzed with the statistical software package Statistical Package for Social Sciences version 11.5 (SPSS Inc.; Chicago, IL, USA). A descriptive analysis was performed; quantitative and qualitative variables were expressed as the mean±standard deviation and percentage and proportions, respectively.

Results

Characteristics of the population studied

During the study period, emergency doctors admitted 1,394 episodes of UTI, of which 268 (19.2%) were in compliance with the HaH admission criteria, whereby they were transferred home to complete the stipulated therapeutic plan (Table 1). The description of the basal characteristics of patients and the most important microbiological characteristics of UTI episodes are summarized in Table 2.

Table 1. Inclusion Criteria for an Episode of UTI in the HaH, Avoiding the Hospital Admission Program of the HUMV

General:
Voluntary participation of the patient and carer(s) after being informed on the
functioning of the HaH
Requirement for a 24 h/day carer in the home of the patient
HaH operating within the catchment area of 15 km from the hospital
Specific:
Commitment on the part of the patients and carer(s) to the S-OPAT scheme
Clinical stability (hemodynamic stability)
Laboratory criteria (suitable stable renal function)
Absence of obstructive acute renal failure using urological ultrasound

HaH: hospitalization at home; HUMV: Hospital Universitario Marqués de Valdecilla; UTI: urinary tract infection; S-OPAT: self-administered outpatient parenteral antimicrobial therapy

Table 2. Basal characteristics, specific features, and microbiological finding of the UTI episodes in HaH

Basal Characteristics	
Age (mean, SD)	59.3 (22.0)
Women (n, %)	142 (53.0)
Existence of comorbidity (n, %)	161 (60.1)
Charlson index (mean, SD)	1.7 (1.9)
Urinary catheter carrier (n, %)	30 (11.2)
Neoplasia of the urinary tract (n, %)	21 (7.8)
Neurogenic bladder dysfunction (n, %)	11 (4.1)
Renal lithiasis (n, %)	7 (2.6)
Specific Type of UTI (n, %)	
Pyelonephritis	84 (31.3)
Urosepsis	63 (23.5)
Complicated cystitis	57 (21.3)
Prostatitis	43 (16.0)
Infection associated with urinary catheter	18 (6.7)
Orchiepididymitis	3 (1.1)
Antibiotics most commonly used (n, %)*	
Ceftriaxone	175 (46.6)
Gentamycin	88 (23.4)
Ertapenem	53 (14.1)
Piperacillin-tazobactam	13 (3.4)
Meropenem	12 (3.2)
Duration of S-OPAT (days, SD)	10.7 (7.1)
Microbiological finding	
Documented microorganisms in urine cultures (n, %)* **	
Total positive urine cultures (n, %)**	156 (61.4)
Escherichia coli	92 (59.0)
Klebsiella pneumoniae	18 (11.5)
Pseudomonas aeruginosa	14 (9.0)
Proteus mirabilis	8 (5.1)
Morganella morganii	6 (3.8)
Documented microorganisms on blood cultures (n, %)	
Total positive blood cultures (n, %)****	19 (14.7)
Escherichia coli	13 (68.4)
Proteus mirabilis	2 (10.5)
Klebsiella pneumoniae	2 (10.5)
Coagulase-negative *Staphylococcus*	1 (5.3)
Morganella morganii	1 (5.2)
Documented MDR microorganisms (n, %)	
Total positive MDR microorganisms in the 175 isolates (n, %)	27 (15.4)
Escherichia coli ESBL	10 (37.0)
Klebsiella pneumoniae ESBL	5 (18.5)
Morganella morganii ESBL	4 (14.8)
Pseudomonas aeruginosa MDR	4 (14.8)
Proteus mirabilis ESBL	2 (7.4)
Providencia stuartii ESBL	2 (7.4)

ESBL: extended spectrum beta-lactamase; HaH: hospitalization at home; MDR: multidrug resistant; SD: standard deviation; UTI: urinary tract infection
*The total number of antibiotics administered was 375. Other antibiotics used were; Ceftazidime, cefepime, amikacin, tobramycin, ciprofloxacin, levofloxacin, amoxicillin-clavulanic acid, aztreonam
**Total number of patients in whom a urine culture was processed: 254 (94.8%). Most (56.1%) patients with a negative urine culture had received antibiotic treatment before the sample was collected.
***Other documented microorganisms: *Enterococcus faecalis,* Coagulase-negative *Staphylococcus, Candida albicans, Ureaplasma urealyticum, Methicillin-resistant Staphylococcus aureus, Providencia stuartii.*
**** Total number of patients in whom blood cultures were processed: 129 (48.1%).

Safety and effectiveness

The results concerning safety and efficacy are summarized in Table 3. Regarding safety, during S-OPAT, only one death occurred at home because of broncho-aspiration in an extremely elderly patient with a highly deteriorated basal functional situation. In 16.1% of patients, a clinical complication appeared mostly unrelated to infection. Most of these (79.1%) could be resolved at home. A total of 20 patients had to return to hospital, nine because of major medical complications. Four of these complications may have been related to the infectious process (two episodes of exacerbation of chronic renal failure, one epileptic crisis probably following the administration of ertapenem, and one case of therapeutic failure despite theoretically correct initial treatment). Another eight patients returned because of socio-familial problems that made it impossible to continue the S-OPAT, and a further three returned because of having scheduled surgery unrelated to the UTI. One of the patients who returned died for reasons unrelated to UTI.

As for efficacy, once the 11 patients that returned to hospital for socio-familial reasons and scheduled surgery were excluded, the healing rate attained in those in whom it was possible to complete the S-OPAT program was 96.5%. During the first month following discharge from HaH, 11 (4.4%) patients who completed S-OPAT were readmitted because of the recurrence of the UTI. A further six did so for reasons outside the scope of the UTI (two because of broncho-aspiration, one because of superinfected pressure ulcers, and three because of scheduled surgery).

Table 3. Safety and efficacy of the HaH program based on S-OPAT during the UTI episodes

Safety	
Mortality (n, %)	1 (0.4)
Total number of patients who returned to the hospital (n, %)	20 (7.5)
Complications that required unexpected return (n, %)	9 (3.4)
2 heart failure	
2 severe exacerbated chronic renal failure	
1 ischemic stroke	
1 therapeutic failure of the UTI	
1 supraventricular tachycardia	
1 hematuria	
1 convulsive crisis	
Complications resolved at home (n, %)	34 (12.7)
5 episodes of diarrhea after antibiotics	
5 episodes of acute urine retention	
5 episodes of exacerbated chronic renal failure	
3 episodes of confusional syndrome	
3 episodes of hematuria	
3 episodes of thrush	
3 episodes of LFT abnormality induced by antibiotics	
2 episodes of unbalanced diabetes	
2 episodes of drug fever	
2 episodes of pseudomembranous colitis	
1 episode of supraventricular tachycardia	
Effectiveness	
Healing rate (n, %)	248 (96.4)
Recurrence of the UTI (n, %)	11 (4.4)

HaH: hospitalization at home; S-OPAT: self-administered outpatient parenteral antimicrobial therapy; UTI: urinary tract infection; LFT: liver functional tests

Discussion

This work reveals that despite the UTI complexity because of its various symptoms (fever, pain, dehydration, etc.) at the time of diagnosis, it is possible to safely and effectively perform S-OPAT within a HaH unit. To the best of our knowledge, our work is novel as there are no precedents in the literature that dealt with this issue.

Thanks to the HaH unit, the ED avoided the admission of almost one in every five patients diagnosed with UTI with hospital admission criteria and obtained from the outset, which had a positive impact on the management of hospital resources (relief of the ED congestion, improved availability of beds in the traditional hospital ward, etc.). In this context, in accordance with recent publications that advocate the need to set out new care strategies that would help to homogenize hospital admission decisions, the HaH could reduce the costs significantly (8). Therefore, Stuck et al. recently concluded that emergency physicians are highly receptive to referring patients to HaH units, but they demand that referral processes be quick (9).

Data obtained in our series share the epidemiological similarities with those observed in recent literature, and they revealed the increasingly more common onset of the MRM strains as causal UTI factors (9). From the microbiological point of view, our series is notable because of its extremely high index of collection of urine cultures with more than 60% coming back as positive; these figures are higher than those found in the literature (approximately 41%) (10). *E. coli* turned out to be the most commonly isolated microorganism, both in urine and blood cultures. The high presence of MRM strains in our series (more than 15% of isolates), well above the 5% from other studies, (11) highlights the important work of our HaH unit with the aim of limiting their dissemination within the hospital setting.

Our S-OPAT program was extremely safe because only a little more than 3% of patients returned to hospital because of major medical complications. The low mortality rate turned out to be more than assumable, given the baseline characteristics of the deceased patient. The results obtained in terms of efficacy were satisfactory, and a healing rate similar to the one published recently by a Spanish group that applied traditional OPAT (12) was attained.

The success of our S-OPAT model in this context is most likely due to several reasons. First, the close collaboration with the ED staff fosters an effective process of patients' home referral (9). However, early administration of antimicrobials and collection of microbiological samples favored a better clinical course in patients, something corroborated by the abundant literature that revealed that both actions improve the prognosis of infectious processes seen in ED (13). Finally, appropriate selection of patients and the efficacy of our HaH unit when responding to any complication at home were essential for the program's success.

Study limitations

We believe the internal validity of our work is high because there was no loss of information. Moreover, the S-OPAT model has been supported in a HaH unit with more than 30 years of experience. However, this study has some limitations, derived specifically from the concrete features of our HaH unit, which can hinder its practical application in other contexts. Such specificities would be their dependence on a tertiary hospital, their close daily collaboration with the ED for referral of any kind of HaH subsidiary process, and finally, their major capacity to provide with their own health care personnel and 24 hours a day, a fast response to any clinical complication of the patient in their own home. All of this can hinder the extrapolation of our conclusions to other medical care contexts.

Conclusion

To conclude, the S-OPAT model supported within a HaH unit is safe and effective in the treatment of complex UTI cases, referred directly from the ED. This also constitutes a doubly useful care tool for the hospital by improving the overall bed management and avoiding the intra-hospital dissemination of MRM strains.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of the Autonomous Community of Cantabria (2017.249)

Informed Consent: Informed consent was not taken from patients due to the retrospective nature of the study.

Peer-review: Externally peer-reviewed.

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