Abstract

**Purpose:** Ureteroscopy is one of the treatment options for the management of refractory ureteric colic. Emergency Ureteroscopy can provide significant symptomatic relief and may reduce the number of hospital attendances compared to Elective Ureteroscopy. Data regarding cost, however, is scarce.

**Materials and Methods:** In this retrospective review, all patients who underwent ureteroscopic treatment for ureteric colic in the year 2015 were identified. Patients who underwent ureteroscopic during an emergency admission for acute ureteric colic were classified as having had Emergency Ureteroscopy, while those who underwent elective ureteroscopy for ureteric colic were classified as having had Elective Ureteroscopy. Exclusion criteria included urinary tract infection, sepsis, prior ureteroscopic procedures and/or ureteric stenting. The primary outcome evaluated was cost; secondary outcomes included number of preoperative attendances for colic, operative outcomes and complications, as well as hospital re-attendances.

**Results:** A total of 88 patients were identified, with 31 in the Emergency group, and 57 under the Elective group. EM was associated with significantly higher procedural and overall costs (p <0.001), but reduced hospital attendance for colic (p< 0.001). There were no significant differences between both groups in terms of stone clearance rate and postoperative reattendances.

**Conclusion:** Emergency ureteroscopy management of ureteric colic is a reasonable treatment modality that reduces hospital attendance and has similar treatment outcomes as elective ureteroscopic treatment; albeit associated with higher financial costs.

Introduction

Conventional modalities of management of acute ureteric colic included placement of a ureteric stent or nephrostomy tube [1-3]. Emergency ureteroscopic stone clearance is one of the emerging treatment modalities for acute ureteric colic, due to advancements in the field of endourology allowing safe and effective treatment with minimal morbidity. To date, there have been no published studies regarding the costs and outcomes of emergency ureteroscopy compared to elective ureteroscopy. Emergency ureteroscopy for definitive stone clearance may reduce costs, hospital reattendances for symptoms and prove to have comparable outcomes as elective ureteroscopy.

Materials and Methods

This is an Ethics Board Committee-approved retrospective review of all patients who underwent ureteroscopy for definitive management of ureteric colic was performed from 1st January 2015 to 31st December at our institution. A total of 91 patients were identified. One patient from the Emergency ureteroscopy (EM) group and 2 patients from the Elective ureteroscopy (EM) group were excluded due to missing data. The exclusion criteria were the presence of an active urinary tract infection, sepsis, and absence of colic symptoms at presentation, previous ureteric instrumentation and/or procedures, and previous ureteric stenting. All patients were diagnosed with ureteric calculi either on X-ray, intravenous urography (IVU), or Computerized Tomography (CT) imaging. The location of the calculi was defined as follows: upper ureter - from renal pelvis to superior sacroiliac joint; midureter - between superior and inferior sacroiliac joint; distal ureter - between inferior sacroiliac joint to vesicoureteric junction.

All 88 patients underwent semi-rigid ureteroscopy, with the possibility of using Holmium laser lithotripsy, forceps retrieval of stones and ureteric stenting if necessary. Ureteroscopy was performed under general anaesthesia, with a 6.4F dual-channel semi-rigid ureteroscope (Olympus) under fluoroscopy. Laser lithotripsy was available if needed, with a 280nm Holmium laser fiber (Lumenis). Ureteric stenting, when performed, was done under fluoroscopic guidance with a multilength 6F ureteric stent (Boston Scientific). Ureteric stenting was performed at the discretion of the clinician, in cases with significant stone impaction, ureteric oedema, tight ureters with failure of access/requiring staged procedure, and in the presence of intraoperative ureteric injury. Stone-free status was confirmed at the end of the surgery with both endoscopic and fluoroscopic assessment. Statistical analysis was performed using SPSS (Statistical Package for the Social Sciences, Version 21.0). Chi-square test, linear regression and ANOVA test were used to compare parameters between the different groups.
Results

The baseline parameters of both groups are seen in Table 1. There was no significant difference in the distribution of the stone locations in both groups. Patients who underwent EM had smaller calculi compared to EU (median = 5mm vs 8mm). The majority in both groups had only a single calculus with a similar proportion of stone location being in the distal ureter or vesicoureteric junction (VUJ). Patients who underwent EU had a statistically higher number of preoperative attendance compared to those who underwent EM. In terms of surgical outcomes, EM was associated with a more challenging intraoperative environment with 32.4% of the patients having difficult ureteric access due to a tight ureter or a difficult ureteric angle. Proximal stone migration was encountered in 6.5% and 3.2% required the use of the flexible ureteroscope due to stone retropulsion intraoperatively.

Table 1: Patient and stone factors.

| Variable                        | Emergency URS (EM) | Elective URS (EU) | p Value |
|--------------------------------|--------------------|-------------------|---------|
| Stone size (mm)                 |                    |                   |         |
| ≤ 5                            | 18 (58.0)          | 9 (15.8)          | < 0.001 |
| 6-10                           | 11 (35.5)          | 36 (63.2)         |         |
| > 10                           | 2 (6.5)            | 12 (21.1)         |         |
| Range                          | 2-12               | 2-20              |         |
| Median                         | 5                  | 8                 |         |
| Multiple stones                | 3 (9.7)            | 3 (5.3)           | NS      |
| Stone location                 |                    |                   |         |
| Proximal ureter                | 7 (23.3)           | 9 (15.8)          | NS      |
| Mid-ureter                     | 2 (6.7)            | 11 (19.3)         |         |
| Distal ureter                  | 10 (33.3)          | 30 (52.6)         |         |
| Vesicoureteric junction (VUJ)  | 7 (23.3)           | 5 (8.8)           |         |
| Multiple locations             | 2 (6.7)            | 1 (1.8)           |         |
| Need for ureteric stenting    |                    |                   | 0.08    |
| Yes                            | 18 (58.1)          | 21 (36.8)         |         |
| No                             | 13 (41.9)          | 36 (63.2)         |         |
| Number of hospital attendances before surgery |  |                   |         |
| 1                              | 15 (48.4)          | 6 (10.5)          | < 0.001 |
| 2                              | 8 (25.8)           | 10 (19.6)         |         |
| 3-5                            | 8 (25.8)           | 37 (72.5)         |         |
| 6-10                           | 0 (0.0)            | 4 (7.8)           |         |
| Range                          | 1-5                | 1-9               |         |
| Median                         | 2                  | 3                 |         |
| Average                        | 1.9                | 3.5               |         |

Significantly, intraoperative complications, the need for staged procedures, stone-free rates, operative duration, and postoperative hospital reattendances rates were not significantly different between the 2 groups. Intraoperative complications included 1 case of ureteric perforation in the EM group and 3 cases of submucosal ureteric injury in the EL group. Staged procedures were required in 6 patients in the EM group for the following reasons: Difficult stone access due to tight ureter in 3; Incomplete stone fragmentation due to tight ureter in 1; And submucosal ureteric injury in 1 due to ureteric strictures distal to stone requiring ureterotomy - this patient underwent ureteric stenting intraoperatively and had interval retrograde pyelogram and ureteroscopic evaluation. A higher proportion of those in the EM group required ureteric stenting (58.1% vs 36.8%) but this did not reach statistical significance. In terms of costs, EM was associated with a significantly higher cost of USD 943.3 for the primary procedure alone, and USD 1103.7 when the costs...
of staged procedures e.g. stent removal are included as well. On linear regression analysis, each additional day of hospitalization was an independent factor resulting in a significant additional cost of USD 330.8 (p < 0.001). The placement of a ureteric stent was associated with an additional cost of USD 429.2 but this did not reach statistical significance (p = 0.16) (Table 2.3).

Table 2: Surgical outcomes.

| Factor                                      | EM     | EL     | p value |
|---------------------------------------------|--------|--------|---------|
| Intraoperative findings                     |        |        |         |
| Tight ureter/difficult ureteric cannulation  | 8 (25.8) | 7 (12.3) | NS      |
| Difficult ureteric angle                    | 2 (6.5)  | 1 (1.8)  | NS      |
| Proximal stone migration                    | 2 (6.5)  | 0 (0.0)  | NS      |
| Need for flexible URS                       | 1 (3.2)  | 0 (0.0)  | NS      |
| Passed stone at surgery                     | 4 (12.9) | 4 (7.0)  | NS      |
| Failure of stone access                     |        |        |         |
| Due to tight ureter                         | 3 (9.7)  | 3 (5.3)  | NS      |
| Retropulsion back to kidney                 | 2       | 3       | NS      |
| Intraoperative complications                 |        |        | 0.66    |
| Yes                                         | 1 (3.2)  | 3 (5.3)  | NS      |
| No                                          | 30 (96.8)| 54 (94.7)|         |
| Need for staged procedures                   |        |        |         |
| Yes                                         | 6 (19.4) | 5 (18.8) | NS      |
| No                                          | 25 (80.6)| 53 (93.0)|         |
| Operative duration (minutes)                 |        |        |         |
| Median                                       | 40      | 41      | NS      |
| Average                                      | 46      | 42      |         |
| Range                                        | 5-117   | 5-89    |         |
| Need for DJ stent insertion                  |        |        | 0.08    |
| Yes                                         | 18 (58.1)| 21 (36.8)|         |
| No                                          | 13 (48.9)| 36 (63.2)|         |
| Stone-free postop                           |        |        |         |
| Yes                                         | 27 (87.1)| 52 (91.2)| NS      |
| No                                          | 4 (12.9) | 5 (8.8)  |         |
| Postoperative sepsis                        |        |        |         |
| 0                                           | 0       | 0       | NS      |
| 1                                           | 2 (6.5)  | 5 (8.8)  | <0.001  |
| 2                                           | 14 (45.2)| 0       |         |
| 3                                           | 8 (25.8) | 0       |         |
| 4                                           | 7 (22.6) | 0       |         |
| Median                                       | 2       | 0       |         |
| Range                                        | 1-4     | 0-1     |         |
| Postoperative hospital reattendance         |        |        |         |
| Yes                                         | 2 (6.5)  | 2 (3.5)  | NS      |
| No                                          | 29 (93.5)| 55 (96.5)|         |
Is it Feasible and Cost-Effective to Perform Emergency Ureteroscopic Treatment for Acute Ureteric Colic?

Table 3

|                        | EM     | EL     | P Value |
|------------------------|--------|--------|---------|
| Primary procedure      | 3011.1 | 2067.8 | <0.001  |
| Cost of primary procedure and stent removal | 3269.5 | 2242.7 | 0.001   |
| Overall cost, including staged procedures | 3502.2 | 2398.5 | <0.001  |

Discussion

EM has comparable stone-free rates and operative outcomes as elective ureteroscopy, albeit at a significantly higher cost. The cost of EM can be largely attributed to the duration of stay - 93.5% stayed for at least 2 days. This can be attributed to the following factors: failure after a trial of medical expulsion therapy (MET) would lead to the clinical decision for emergency ureteroscopy; the median waiting time for emergency surgery was 26h; and most patients would stay an additional day post-surgery for symptom monitoring before they are discharged. In contrast, EL is performed as Day Surgery procedures [4-8].

Conclusion

EM is a reasonable option for acute management of ureteric colic, with comparable outcomes and stone-free rates as elective ureteroscopic surgery. Although overall costs are higher compared to elective surgery, patients enjoy quicker symptom relief, earlier return to work with potential reduction in health-related productivity loss. The authors have no conflict of interests and no funding was required for the study.

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