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ORIGINAL ARTICLE

A review of studies reporting on complications of upper urinary tract stone ablation using the holmium:YAG laser

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Review

Summary
Purpose: A review of the literature of studies reporting complications of ureteroscopic urinary tract stone ablation using the holmium:YAG laser was performed.
Patients and methods: Electronic databases were searched using specific keywords to identify relevant studies. Reference lists of identified articles were scrutinised for other studies and searches were conducted using the names of authors known to have published widely in this field. Two reviewers assessed retrieved articles for inclusion criteria. Patients <16 years old were excluded.
Results: Overall, 48 studies published between 1994 and 2007 were included. Half were published since 2000. In total, 4454 patients were identified. Around half of studies were performed in North America (25). The number of patients per study varied from 8 to 598. The study populations were very heterogeneous in terms of stone position and size, and ureteroscope size and rigidity. Overall, 303 (6.8%) complications were identified. Post-operative ureteric stricture and perforation rates were both 1.0%. There were only six major complications identified (0.1%). The post-operative sepsis rate was 2% and one death was reported.
Conclusions: Upper urinary tract stone ablation using the holmium:YAG laser is both safe and reliable. Follow-up imaging to detect procedure-specific complications would not appear to be routinely indicated given this low complication rate.

Abbreviations: Holmium:YAG, holmium yttrium—aluminium—garnet; CVA, cerebrovascular accident; DVT, deep vein thrombosis; URTI, upper respiratory tract infection; UTI, urinary tract infection; AUA, American Urological Association.

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Introduction

Recent improvements in ureteroscope design, together with increased utilisation of the holmium yttrium—aluminium—garnet (holmium:YAG) laser have led to decreased reported complication rates in numerous studies of ureteroscopic stone fragmentation [1—3]. The holmium:YAG laser has a wavelength of 2100 nm, a pulse energy of 0.2—0.4 J/pulse, and delivers a power of between 3.0 and 100 W, although the higher powers are not applicable to stone surgery [4,5]. Laser fibres of 200—1000 μm are used to perform endourological procedures. The holmium:YAG laser has a tissue penetration of approximately 0.5 mm and acts by superheating water, creating microbubbles at the tip of the laser fibre [6,7]. This process creates a mechanical disruption on collapse of the microbubbles that fragments and vaporizes urinary tract calculi. Continuous irrigation is used to minimise the thermal effect of the laser. These properties are thought to achieve more effective stone fragmentation with a lower risk of trauma and subsequent complications than most other modalities of ureteroscopic stone fragmentation.

The first publication regarding the use of the holmium:YAG laser in urology was in 1993 [8]. Within urology this laser has also been utilised in the treatment of other benign conditions such as ureteric strictures and bladder outflow obstruction, and also in malignant conditions such as bladder and ureteric tumours [9]. The addition of the holmium:YAG laser to the urological armamentarium has led to improved success rates for ureteroscopic lithotripsy. Technological advances in fibre optics now permit access to the entire upper urological tract and consequently the indications for ureteroscopic stone ablation have increased [10—12]. We performed a review of the literature of studies reporting complications of upper urinary tract ureteroscopic stone ablation using the holmium:YAG laser.

Materials and methods

Search strategy

The review aimed to identify all studies reporting complications following upper urinary tract ureteroscopic stone ablation using the holmium:YAG laser. The following electronic databases were searched: MEDLINE, EMBASE and the Cochrane Library. The searches were performed using both keywords and MeSH headings to identify all relevant studies. The reference lists of all identified articles were scrutinised for other relevant studies and electronic searches were also conducted using the names of key authors who were known to have published widely in this field of study. Finally, the European Association of Urology (EAU) Guidelines on Urolithiasis were also reviewed [13]. Two reviewers assessed the retrieved articles for inclusion and exclusion criteria. The same reviewers extracted data from included articles. Disagreements in either study inclusion or data extraction were resolved by a third reviewer.

Inclusion criteria

Studies were included if they provided data regarding complications following upper urinary tract stone ablation using the holmium:YAG laser. For the purposes of this review, the upper urinary tract was defined as any point within the urinary tract proximal to the ureteric orifice. Studies were excluded if they did not contain primary empirical data (i.e. reviews, letters, editorials and comments). Only patients undergoing retrograde ureteroscopic stone ablation were included—patients on whom stone ablation was performed using either percutaneous or antegrade ureteroscopic surgical techniques were excluded from the analysis. We also excluded patients less than 16 years old from any included studies and studies not published in English.

Data extraction

Data were extracted from each study regarding country of study origin, time period of study, number of patients, recorded complications, stone position and size, and ureteroscope rigidity and size (see Tables 1 and 2). Data were also extracted on post-procedure ureteric stenting rates and holmium:YAG laser fibre diameter. The studies were summarised in tabular form (Table 1). Due to the heterogeneity in stone position and size, and ureteroscope size and rigidity across studies, it was not possible to perform a meta-analysis.

Results

Included studies

Overall, 48 studies published between 1994 and 2007 were included in the review (Table 1) [14—52]. Half of these studies were published since 2000. The earliest study included was published in 1994