African Urology 2023;3:140-145
https://doi.org/10.36303/AUJ.0057

AFRICAN UROLOGY
ISSN 2710-2750 EISSN 2710-2750

REVIEW

Ipsilateral ureteroureterostomy versus upper moiety heminephrectomy (and proximal ureterectomy) for a complete duplex system of the kidney: a mini-review

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Background: A complete duplicated renal collecting system associated with an ectopic ureter or an ureterocele is a rare congenital abnormality which may require surgical intervention to resolve symptoms or improve drainage of an obstructed renal unit at risk of loss. Corrective surgery can be divided into upper tract, lower tract, or combined approaches, with the decision largely dependent upon clinical context. This review set out to describe the differences in outcomes between approaches and hence provide clarity in terms of decision-making, specifically regarding symptomatic or obstructed upper moieties.

Materials and methods: This mini-review relied on a predefined search strategy of the Ovid MEDLINE database to select appropriate articles to allow for a comparison between these two interventions. The predefined medical subject headings for this search included "duplicated ureter", "duplex system", "ipsilateral ureteroureterostomy", "upper pole heminephrectomy", and "upper pole nephrectomy". The search involved two reviewers working independently.

Results: Based on the available evidence, a direct comparison between differing approaches is not feasible. A lower tract approach in the form of an ipsilateral ureteroureterostomy (IUU), regardless of upper moiety function, is a safe procedure with rates of postoperative febrile urinary tract infections (UTI) and requirement for reoperation comparable to an upper moiety heminephrectomy (UMH). An IUU has a lower risk of lower moiety loss compared to a UMH. Lower moiety hydronephrosis, ureterocele and concomitant bladder reconstruction or re-implantation are predictors of adverse outcomes in patients undergoing an IUU.

Conclusion: This review confirms the safety of a lower tract approach in managing patients with a complete duplicated collecting system. Given its lower risk of damage to the remaining renal unit, it should be considered, provided no significant lower moiety pathology contraindicates its utilisation.

Keywords: ureteral duplication, adult, ipsilateral ureteroureterostomy

Introduction

Ectopic ureter implantation has an incidence rate of 0.05–0.025% and is usually associated with duplex collecting systems and has a strong female predominance.[1] Presentation depends on the exact anatomical configuration of the congenital anomaly. The anomalies can be associated with ectopic ureters, ureteroceles, obstruction, vesicoureteral reflux (VUR), urinary tract infections (UTIs), incontinence, and varying degrees of renal function loss.[2,3] There are multiple surgical approaches to correct these disorders when sequelae are sufficient to warrant intervention, with little high-quality evidence to favour certain approaches over others. Traditional opinion has favoured an upper tract ablative procedure for an upper moiety with poor function.[3] There have been several studies highlighting the benefit of an approach favouring reconstruction using an ipsilateral ureteroureterostomy (IUU) as an alternative.[3-5] This review aims to assess whether there is a difference in outcomes of symptom resolution and complications, comparing an IUU to a upper moiety heminephrectomy (UMH) for patients with a complete duplex collecting system.

Methods

The clinical question was formulated using the Population, Intervention, Comparison, Outcome (PICO) format. A tabulated summary of this is provided below in Table I.

Population

The patient population included in this review were all from cohorts published, which reported on outcomes of those who underwent either surgical procedure under interrogation. An underlying diagnosis of an ectopic ureter or ureterocele in the presence of a duplex system was mandated.

Intervention

IUU done via an open, laparoscopic, or robot-assisted technique.

Comparison

UMH (and proximal ureterectomy) done via an open, laparoscopic, or robot-assisted technique.

Table I: The PICO framework used to formulate the search strategy

Population (1)	Intervention (1)	Comparison (2)	Outcome (3)
Complete duplex system with an ectopic ureter or ureterocele	IUU	UMH Upper pole nephrectomy	Symptom resolution Renal function preservation Postoperative complications

Outcome

Symptom resolution, postoperative UTI, renal preservation, postoperative complications including repeat procedures.

Studies selection

Although randomised controlled trials would likely represent the highest level of evidence, for this specific condition there are no randomised controlled trials due to the nature of the condition and the relative scarcity. Studies included are retrospective analyses with no comparative trials available.

Inclusion criteria: patients with an ectopic ureter or ureterocele associated with a complete duplex system requiring surgery, English language, from the year 2000, published full-text articles.

Exclusion criteria: patients with lower moiety hydronephrosis, likely due to a high-grade VUR requiring concomitant ureter re-implantation, cases undergoing renal transplantation, case reports, and endoscopic management.

Information and search strategy

The search was conducted with a predefined search strategy to ensure reproducibility should the search be subjected to the scrutiny of external review. Two reviewers (CE and AB) independently screened abstracts, assessed full texts for inclusion, and reviewed the results included. The Ovid MEDLINE database was used to search for articles included in this study. The search strategy focused on including all relevant articles that used either an IUU or a UMH in treating an ectopic ureter associated with a duplex system. The predefined medical subject headings for this search included “duplicated ureter”, “duplex system”, “ipsilateral ureteroureterostomy”, “upper pole heminephrectomy”, and “upper pole nephrectomy”. The Ovid MEDLINE search strategy is described below in Table II.

Table II: Search strategy

Predefined medical subject headings	Number of studies
Duplicated ureter	70
Duplex system	370
Ipsilateral ureteroureterostomy	42
Upper pole nephrectomy	47
Upper pole heminephrectomy	56

Article selection

Articles retrieved following the database search were imported to the Covidence website, which was used to facilitate screening and study selection.[6] This platform allowed for two reviewers to independently assess abstracts for trial design and interventions of the condition under investigation, factoring in inclusion and exclusion criteria. Agreement on conflicting assessments was achieved through in-person discussion. References of included articles were also assessed where appropriate.

Risk of bias assessment

The risk of bias will be addressed and certainty of evidence using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach will be utilised.[7] A formal risk of bias assessment is, however, not achievable due to the nature of the studies undertaken.

Results

There are no prospective studies available that allow for an accurate comparative analysis of the two interventions. There is an inherent risk of bias, based on the nature of all studies assessed, as these are retrospective analyses which invariably means that baseline confounding would be present in terms of patient and surgical procedure selection. The PRISMA diagram shown below (Figure 1) gives a graphical presentation of the review process with 60 full-text studies being reviewed, of which 34 met the criteria to be included.[8] Reasons for excluding texts included: six wrong interventions, six wrong outcomes, six wrong study designs, five wrong settings, two unable to access the full text, and one wrong patient population.

Incontinence

Heterogeneous median ages between cohorts make incontinence on presentation and resolution difficult to stratify, but both techniques are comparable in terms of this specific symptom resolution.

Hydronephrosis

Consistently improved or resolved hydronephrosis is reported in series where this has been routinely followed up post-IUU, although this is clearly not a comparable outcome parameter for a UMH.[9,10]

Lower moiety loss

No cases of lower moiety loss were reported in patients undergoing an IUU, whereas a rate of 0% to 7% of lower moiety loss in patients who underwent a UMH. Results are summarised in Table II.

Urinary tract infection

Postoperative UTI rates range from 0–28.2% in patients undergoing IUU, with a rate of 0–29.4% in patients undergoing UMH.

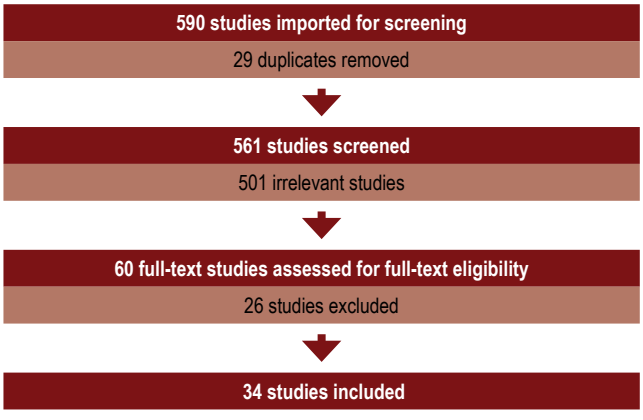

Figure 1: PRISMA diagram[8]

Complications

Patients requiring a secondary procedure (as a Clavien–Dindo III complication or a planned secondary procedure) showed that those having an IUU had a range of 0–15.4% compared to UMH which had a range of 0–35.5%.[11] It is important to note that although the need for a second procedure is higher within the cohorts of patients who underwent UMH, this would likely represent a group of patients whose underlying congenital abnormalities warranted multiple procedures to manage, as opposed to a genuine reflection of differences in outcomes between the two procedures. The incidence of postoperative anastomotic stricture is seemingly low with only two trials reviewed reporting this complication with a rate of 2% being reported by both Lashley et al.[12] and McLeod et al. post-IUU.[13]

Discussion

This review set out to determine whether IUU is comparable to UMH in terms of success and complication rate when treating a complete duplex system. The aim would thus provide insight into factors that affect decision-making and ultimately facilitate a recommendation for the preferable decision within certain clinical scenarios. Although a mini review, this study used a pre-specified search strategy that is reproducible and was undertaken by two authors working independently to screen abstracts, assess full texts, and select appropriate studies, consequently improving the robustness of the findings. This review also highlighted the different terminology used to describe the procedure of UMH and hence makes a case for standardisation to facilitate future result reporting and cross-centre comparison. We are not comparing the management options directly, but rather summarising the benefits and complications of each procedure.

Management options for a duplex renal collecting system discussed in the literature include common sheath re-implantation, ureter re-implantation of the ectopic ureter, UMH, IUU, and ureteral clipping.[3,41] The two most commonly published surgical management options for complete duplex systems include a UMH where the upper pole moiety is excised versus an IUU which preserves the upper pole moiety and re-implants the ectopic upper pole ureter into the lower pole ureter via an end-to-side anastomosis.[2,20] Both IUU and UMH can be performed through different techniques, namely: laparoscopic, open, or robot-assisted.[2]

The decision between UMH and IUU remains controversial and depends on numerous factors, namely: the age of the patient, the surgeon's experience and preference, the degree of VUR or ureter obstruction, pathology of the ureters or kidneys, and the presence of a ureterocele.[2] Certain procedures are chosen based

Table III: Studies conducted using IUU

Study	Type	Procedure	Technique	*n*	Females	Mean age (years)	Follow-up (mean months)	Improvement of HN (%)	Postop-UTI	Reoperation (%)	Progressive HN	Notes
Abdelhalim et al. 2019[5]	RA	IUU	Open	35	27	1.2	36.7	89.3	20	11.4	8.6	
Biles et al. 2016[9]	RA	IUU	Robotic	12	8	1.6	11	100	0	0	0	
Chacko et al. 2007[14]	RA	IUU	Open	39	31	2.6	12	100	NR	15.4	0	
Chandrasekharam and Jayaram 2015[15]	RA	IUU	Laparoscopic	8	5	1	19	100	0	0	0	
Choi and Oh 2000[6]	RA	IUU	Open	13	NR	NR	NR	NR	NR	15.4	NR	
Gonzalez and Piaggio 2007[17]	RA	IUU	Laparoscopic	6	4	4.3	10.7	100	33.3	0	0	
Harms et al. 2019[4]	RA	IUU	Open	42	32	2.9	20	NR	9.5	4.8	9.5	
Kawal et al. 2019[3]	RA	IUU	Robotic + open (40/13)	53	38	1.1	27.5	100	9.4	1.9	0	*84.9% complete resolution in HN
Lashley et al. 2001[12]	RA	IUU	Open	100	66	2.3	33	NR	4	7	NR	
Leavitt et al. 2012[10]	RA	IUU	Robotic	5	4	5.1	10	100	20	0	0	
Liem et al. 2012[18]	RA	IUU	Laparoscopic (intra + extracorporeal)	9	8	2.1		100	NR	0	0	
McLeod et al. 2014[13]	RA	IUU	Laparoscopic + open	41	35	2.3	33.6	95.1	NR	4.9	4.9	Tortuous ureter resulted in obstruction
Sahadev et al. 2022[19]	RA	IUU	Robotic	39	31	2.4	16	NR	15.4	0	NR	
Storm et al. 2010[20]	RA	IUU	Laparoscopic	7	7	7	8	100	0	0	0	

IUU – ipsilateral ureteroureterostomy, RA – retrospective analysis, NR – not reported, UTI – urinary tract infection

Table IV: Studies conducted using UMH

Study	Type	Procedure	Technique	*n*	Females	Mean age (years)	Follow-up (median months)	Postop-UTI (%)	Reoperation (%)	Loss of lower moiety (%)	Notes
Abedinzadeh et al. 2012[21]	RA	UMH	Laparoscopic	14	10	24.2	32	0	0	7	
Ade-Ajayi et al. 2001[22]	RA	UMH	Open	55	39	2.3	37	NR	9.1	NR	
Barroso et al. 2005[23]	RA	UMH	Open	5	4	NR	2	NR	0	0	
Cezarino et al. 2021[24]	RA	UMH	Open + laparoscopic	28	26	1.3	84		30.7	NR	
		UMH + extended ureterectomy	Open + laparoscopic	16	11	1.4	42.5		6	NR	
Choi and Oh. 2000[16]	RA	UMH	Open	30	NR	NR	NR	NR	16.7	NR	
Dénes et al. 2007[25]	RA	UMH	Laparoscopic	17	NR	NR	57.1	29.4	15.8	5.3	
Dönmez et al. 2015[26]	RA	UMH	Laparoscopic	10	4	41.2	NR	20	20	NR	
Hisamatsu et al. 2012[27]	RA	UMH	Open	21	20	2.8	52	23.8	23.8	NR	
Horowitz et al. 2001[28]	RA	UMH	Laparoscopic	13	8	3.8	NR	NR	0	NR	
Jayram et al. 2011[29]	RA	UMH	Laparoscopic	142	51	1	54	0.7	4.2	4.9	
Joyeux et al. 2017[30]	RA	UMH	Laparoscopic	25	19	2.5	86	20	20	0	17% partial function loss
Marte et al. 2015[31]	RA	UMH	Laparoscopic	22	9	3.9	70.8	0	0	0	*5 per-renal cysts, all managed conservatively
Mason et al. 2012[32]	RA	UMH	Robotic	4	2	43.8	13	0	0	0	
Miranda et al. 2007[33]	RA	UMH	Laparoscopic	7	NR	0.8	18	0	0	0	
Olsen and Jorgenson 2005[34]	RA	UMH	Robotic + open	14	14	4.9	8	7.1	7.1	NR	
Pearce and Subramaniam 2011[35]	RA	UMH	Open	31	23	3.2	NR	NR	16.1	NR	*ureterocele determines need for reoperation
Polok et al. 2019[36]	RA	UMH	Laparoscopic	33	26	3.5	42	12.1	9.1	2 out of 15	13.3% partial function loss
Qin et al. 2019[37]	RA	UMH	Robotic	7	5	24	24	0	0	0	
Roshan and MacNeily 2020[38]	RA	UMH	Open	49	40	2.1	22.3	12	20.4	2	
Sahadev et al. 2022[19]	RA	UMH	Robotic	28	22	1	10.8	10.7	3.6	*	Median loss 6% in 8 patients scanned
Singh et al. 2019[39]	RA	UMH	Laparoscopic	17	10	32	8	0	17.8	NR	
Szklarz et al. 2021[40]	RA	UMH	Laparoscopic	130	94	2.2	38.4	18.5	5.4	0	17% had > 5% loss

UMH – upper moiety heminephrectomy, RA – retrospective analysis, NR – not reported, UTI – urinary tract infections

on the underlying pathology. Traditionally, UMH is the preferred choice of management for cases where the upper pole moieties have a poor function. However, there is a risk of lower moiety loss secondary to vascular injury, due to unrecognised segmental renal artery ligation, or vasospasm, with an overall complication rate of 5–10%.[29] Complications include urine leak, bleeding, and loss of the functional lower moiety.[29] Complete loss of the lower moiety assessed on long-term follow-up accounted for up to 4.9% of cases described by Jayram et al.[29] A study done on 60 patients by Gundeti et al.[42] reported a decrease in renal function of 6.8%, whilst 8% of the patients experienced a decrease of greater than 10%.

In contrast, a study conducted in 2013 by McLeod et al.[13] showed that an IUU can safely be performed even if the upper pole moiety is poorly functional or non-functional. This observation was later confirmed by Kawal et al.[3] who described no difference in terms of outcomes (complications, need for secondary interventions, or radiographic resolution) when their cohort was divided by function of moiety < 10% and ≥ 10%. The median function in the poor moiety function group was 0%.[3] Levy et al.[43] reported in their study that the preservation of the upper tract is not linked to an increased risk of hypertension after a 15-year follow-up showed that there was not a statistically significant difference in risk for development between UMH and surgeries which preserve the upper moiety. The most likely pathophysiology resulting in hypertension is chronic pyelonephritis, as there is usually focal dysplasia, which is seldom significant, in histological analysis of partial nephroureterectomies.[43,44] Another important note is that the finding of postoperative hypertension is largely skewed by selection bias.

IUU does not place the kidney at direct risk of damaging the functional renal moiety.[3] IUU has a low risk of reoperation rates irrespective of preoperative VUR or the degree of donor ureteral dilation.[5] This important observation was shown by Harms et al.[4], in that a larger diameter of the upper moiety ureter (≥ 1.2 cm) does not seem to have a negative impact on the outcome following IUU. A large donor ureter was in fact shown to be associated with a more pronounced reduction in hydronephrosis and ureter diameter.[4] Anastomotic stricture rates were as low as 2% in the study conducted by McLeod et al.[13] Concerns regarding the theoretical "yo-yo" reflux have not been ubiquitously observed across all cohorts, but some observations have challenged this concept.[5] IUU can be done via a distal approach using a Pfannenstiel or Gibson incision, which allows for a more complete excision of the ectopic ureteral stump, therefore reducing the risk of UTI.[5,45] This is an important consideration as a retained ureteral stump could account for up to 10% risk of reoperation.[46] Important predictors of this are shown to be a larger donor ureteral diameter and the extent to which the distal upper moiety ureter is dissected.[2,24,46] No intervention should be used indiscriminately. The greatest predictors of adverse outcomes following IUU are both upper and lower moiety hydronephrosis, ectopic ureteroceles, as well as situations where a concomitant ureter re-implantation is required.[5]

Strengths of this study include the appropriate methodology in conducting the review, the fact that it was done by two reviewers, and the results include literature published this year so it may be considered an up-to-date review on the topic. Weaknesses of this review include the trial design of studies incorporated (retrospective analysis without any comparative studies or randomised data), inherent selection bias, the fact that only one database was used, and the fact that no protocol was available. Similar reviews have been published, although this review does contain studies published within the last five years.[2] A further benefit of this review would be in reaching a local readership audience within South Africa where IUU is seemingly an overlooked surgical option in treating patients who would qualify for the procedure.

Albeit based on small cohort sizes without prospective and comparative data, the literature reviewed supports the use of IUU for the appropriately selected patient in treating a complete duplex system. There is no possible evidence-based GRADE recommendation.[7] Good clinical practice would include first considering any procedure where the risk of harm (i.e. functional renal parenchyma loss) is the lowest. Secondly, it is important to consider whether the lower moiety is normal (no hydronephrosis) and whether a ureterocele is present, as concomitant re-implantation or bladder reconstruction are predictors of adverse outcomes in IUU. In the setting of a seemingly non-functioning upper pole moiety, IUU is still a safe and feasible surgical procedure, with good renal preservation and comparable complication rates. Most importantly, IUU does not expose the lower moiety to the same risk of loss as a UMH does.

Conclusion

IUU is a viable option to treat anomalies associated with a duplex renal collecting system, which can be safely done with an acceptably low morbidity rate and higher renal function preservation rate compared to UMH. IUU can be used for the appropriately selected patient, regardless of the upper moiety function.[3,13] Heterogeneity in patient selection precludes a direct comparison between outcomes. Well-designed prospective trials where direct comparison is available will have to be done to provide a better level of evidence in direct comparison between the two methods. Consensus in the definition is crucial to accurately compare literature and outcomes.

Acknowledgements

Dr Chris Evans would like to acknowledge the input of his moderators from the University of Edinburgh, ChM (Urology) programme. For this case, particular thanks need to be given to the paediatric moderators: Mr Stephen Griffin, Mr Milind Kulkarni, and Mr Pankaj Mishra, who encouraged critical thinking on this topic.

Conflict of interest

The authors of this research declare that no specific grant from funding agencies in the public, commercial, or not-for-profit sectors was provided.

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