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Management of Ureters Involved in Inguinal Hernias

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Background: The presence of a ureter in a hernia sac presents a unique surgical challenge and can increase the likelihood of ureteral injury at the time of surgery as they are often not identified pre-operatively. Here we present our institutional experience and review of the literature in order to provide guidance on the urologist's role in this situation. **Materials and Methods:** A PubMed and Medline search was conducted to identify relevant literature published in the year 2000 or later. Case reports and case series in the English language were included using terms "ureter and hernia", "herniated ureter", "ureteral hernia", "inguinal hernia and ureter". **Results:** The presence of a ureter in an inguinal hernia sac is an uncommon finding. When present, many are not identified pre-operatively, which places the patient at risk for ureteral injury during herniorrhaphy. Patients with ureters contained in their inguinal hernias, that were identified pre-operatively or intra-operatively and not injured, recovered well. Post-operative imaging, when performed, showed stabilization or improvement of hydronephrosis and a more normal course of the ureter. One case reported the identification of ureteral involvement post-operatively after injury, which resulted in worsened renal function and required a re-operation. **Conclusions:** The presence of a ureter in an inguinal hernia can be differently managed. The primary goal should be avoidance of injury intra-operatively.

ureteral hernia | inguinal hernia | hydronephrosis | renal ectopia

The presence of a ureter in an inguinal hernia sac is uncommon and likely underreported event (1). The literature is scarce on this topic and discusses a variety of methods of management ranging from ligation of ureters in non-functioning kidneys to placement of ureteral stents or percutaneous nephrostomy tubes (PCNT) (1-4). Identification of the herniated ureter before or during the surgery can be a concerning finding for the operating general surgeon and usually prompts a urologic consult. The data on how to best manage these ureters and renal units - whether with or without hydronephrosis - are sparse. Ideally, identifying this problem on pre-operative imaging can potentially reduce the likelihood of ureteral injury during hernia repair. Since obtaining cross-sectional imaging is not a routine for all patients undergoing inguinal herniorrhaphies, these ureters are often a surprising intraoperative finding. This paper will discuss our institutional experience with these patients and review the literature to date to provide guidance for other urologists and general surgeons facing this unusual clinical scenario.

Methods

We present two cases that had the rare finding of ureters entrapped within the inguinal hernia sac. Institutional Review Board (IRB) approval was not required for this study.

Case 1.

A 71-year-old man was admitted for pre-operative medical optimization prior to undergoing left inguinal hernia repair for a large symptomatic left inguinal hernia. Pre-operative computed tomography (CT) scan revealed an indirect incarcerated left inguinal hernia with the left ureter contained within the hernia sac (Figure 1).

We elected to perform a retrograde pyelogram and stent placement prior to herniorrhaphy (Figure 2). This confirmed the course of the ureter through the hernia sac with significant redundancy of the ureter; notably, a 28 cm ureteral stent barely reached the renal pelvis.

Case 2

A 65-year-old man was admitted with acute on chronic renal failure and significant right hydronephrosis. The patient had a very large chronic right indirect inguinal hernia which was asymptomatic. CT scan revealed his right ureter contained within the hernia. In this patient a ureteral stent was placed pre-operatively for optimization of renal function. We again experienced difficulty due to an elongated, tortuous ureter, however we were eventually able to place a 30 centimeter stent into the renal pelvis. The patient's creatinine declined slightly after stent placement but did not return to baseline.

A PubMed and Medline search was conducted to identify relevant literature published in the year 2000 or later. Case reports and case series in the English language were included using terms "ureter and hernia", "herniated ureter", "ureteral hernia", "inguinal hernia and ureter". Case reports or series with discussion of management of the ureter were included. Case reports that involved transplanted kidneys or herniated bladders were excluded. Including our own series, 12 series with only 17 cases were identified and included in our analysis (Table 1).

Results

The most common presentation were patients with symptomatic hernias referred to a general surgeon for repair (1, 2, 5-7, 9), although rarely patients presented initially to a urologist with renal colic (8, 10). Of the 17 cases reviewed, 10 patients (58.8%) were being evaluated for symptomatic inguinal hernia (1, 2, 5-7, 9), four patients (23.5%) for renal insufficiency and hydronephrosis (1, 3,

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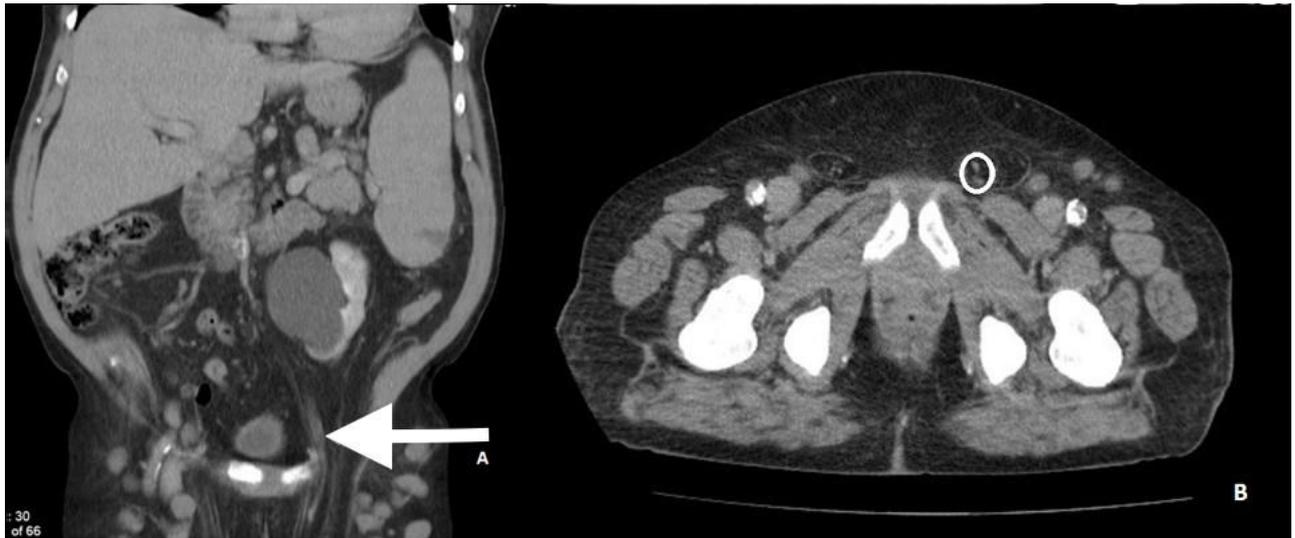


Figure 1. A: Coronal CT showing left ureter entering hernia sac. Left kidney inferiorly displaced. B: Axial CT showing left ureter entering and leaving the hernia sac.



Figure 2. A: Retrograde pyelogram showing left ureter in the inguinal hernia sac. B: Postoperative abdominal X-ray showing redundancy of stented left ureter.

11), two patients (11.8%) had renal colic (8, 10) and one patient (5.9%) presented with incidental findings during workup for another ailment (4). In 15 (88.2%) of the cases, the ureter was identified in the hernia sac prior to operative intervention (1-6, 8-11).

Three of these patients were primarily being worked up for urologic symptoms (4, 11), while 12 patients were being evaluated for large symptomatic inguinal hernias. In two patients (11.8%), ureteral involvement was not identified prior to surgical intervention for the hernia (1, 7). In one patient, the ureter was identified intra-operatively, reduced with the hernia contents and follow-up imaging revealed a normal upper urinary tract (7). In the second pa-

tient, the ureter was presumed to have been located within the hernia sac after delayed identification of a ureteral injury, which resulted in hydronephrosis and drainage of urine from the surgical incision (1). In eight patients (53.3%), who were diagnosed pre-operatively, urologic intervention was attempted pre-operatively, such as retrograde pyelogram and attempted placement of a ureteral stent (1-4). Ureteral stents were successfully placed in five patients (1, 2, 4), while the other three patients had percutaneous nephrostomy tubes placed.

Table 1. Analysis of studies meeting criteria for inclusion (1-11). *IVU: intravenous urogram.

Author	Presentation	Diagnosis	Indication for intervention	Pre-op GU intervention	Intervention	Outcome
Ahmed et al. (2016)	hernia	IVU*	symptomatic hernia	none	herniorrhaphy	ureter in appropriate position on follow-up IVU
Allam et al.(2015)	hernia	postop injury	symptomatic hydrocele hernia	none	hydrocelectomy, herniorrhaphy	hydronephrosis, renal atrophy from ureteral injury
	renal insufficiency	CT	hydronephrosis, renal insufficiency	attempted retrograde stent, PCNT	herniorrhaphy, ureteral resection and reimplant	resolution of hydronephrosis
	hernia	CT	hydrocele, renal atrophy	none	herniorrhaphy, hydrocelectomy, scrotoplasty, ligation of ureter	recovered well
	hernia	CT	not reported	ureteral stent	herniorrhaphy	no ureteral injury
	hernia	CT	symptomatic hernia	PCNT	herniorrhaphy	successful herniorrhaphy
Eilber et al.(2001)	hernia	CT	symptomatic hernias	none	none	not reported
Falidas et al. (2015)	hernia	intraoperative	not reported	none	herniorrhaphy	no ureteral injury
Giglio et al. (2001)	renal colic	IVU	non-reducible hernia	none	herniorrhaphy	not reported
Giuly et al. (2002)	hernia	IVU	not reported	none	herniorrhaphy	post-op IVU with ureter in normal position
Latowsky et al. (2013)	hernia	CT	inguinal pain	ureteral stent	herniorrhaphy	no ureteral injury
Massoud et al. (2010)	renal colic	CT	hydronephrosis, flank pain	none	herniorrhaphy	resolution of hydronephrosis
McKay et al.(2014)	renal insufficiency	CT	urethral obstruction, renal failure	attempted ureteral stent, bilateral PCNT	bilateral ureteral reimplants, bilateral inguinal hernia repairs	recovered well
Won et al.(2012)	renal insufficiency	CT	ureteral obstruction, renal failure	none	none	not reported
Yahya et al. (2017)	incidental	CT	ureteral calculus	ureteral stent	herniorrhaphy	no ureteral injury
Perz, et al. (2018)	hernia	CT	ureteral stent	herniorrhaphy	ureteral calculus	no ureteral injury
	renal insufficiency	CT	large hernia, renal failure	ureteral stent	herniorrhaphy	no ureteral injury

The degree of hydronephrosis and renal atrophy varied at the time of presentation, however the majority of patients displayed little or no evidence of upper urinary tract damage. In the patient with delayed post-operative identification of ureteral injury, the hydronephrosis worsened after surgical intervention (1). It was reported in 4 patients that post-operative urologic imaging confirmed stabilization or improvement of hydronephrosis and appropriate position of the ureter (1, 5, 9).

Discussion

A ureter in a hernia sac is a rare condition but can have serious complications, including intra-operative injury to the ureter, hydronephrosis and renal failure. Ureters are more likely to be involved in large inguinal hernias containing other visceral structures and should be an indication to obtain imaging of the pelvic region prior to intervention. In patients with ipsilateral hydronephrosis or renal colic, a high index of suspicion should be maintained, thus representing another indication to obtain pelvic imaging prior to intervention.

Identification Patients are not routinely imaged prior to inguinal hernia repair. Involvement of the ureter should be suspected in patients with ipsilateral renal colic or previously detected hydronephrosis [12]. If there is suspicion of ureteral involvement, imaging of the ureter can be pursued in the form of CT Urogram, IV Urogram or retrograde pyelogram. The most commonly employed technique is CT Urogram, which can be helpful for the planning of the operation, as it will provide further information about the contents of the hernia sac. Pollock et. al discussed in depth findings associated with herniated ureters and speculated that the commonly identified inferior displacement of the kidney is due to loss of fat in the retroperitoneum leading to loss of support of the kidney rather than downward traction of the ureter itself (12). Previous reports have identified patients at increased risk of ureteral involvement as those with anterior displacement of the ureter at level of L4 on CT and obese males in their fifth and sixth decade of life (12). Ureteral involvement is more common in indirect rather than direct hernias (80% v. 20%) (4). Involvement of renal transplant ureters is a much more common finding and ipsilateral inguinal hernias should always be carefully examined for ureteral involvement in the transplant population (12).

Perioperative management For most patients, the treatment plan is not significantly altered due to the presence of a ureter within the hernia sac. In seven (41.2%) of the cases we reviewed, a urologic problem was listed as an indication for surgery (Table 1). In these cases, a urologic problem such as hydronephrosis or renal insufficiency may have persuaded the patient to pursue surgical correction of the hernia sooner than if they had no urologic involvement. In the urologic literature there are no uniform recommendations for managing ureters located in hernia sacs. If the kidney is functional, avoidance of ureteral injury at the time of surgery should be of paramount importance. Whether to place a ureteral stent is a decision to be made by collaboration between the general surgeon and the urologist. Certainly, if there is evidence of significant obstruction a stent can be placed to optimize renal function. Similar to use of ureteral stents preoperatively in complex gynecological or colorectal resections, cannulation of ureters can potentially minimize the chance of injury in these patients. Stent placement in this situation is particularly difficult due to long, tortuous ureters. In one series of five cases, only one patient had successful pre-operatively placement of a ureteral stent; failure in the other patients was due to a variety of obstacles, including technical difficulty due to redundancy of the ureter, and futility in non-functioning kidneys. In one patient, the ureter was not identified pre-operatively (1). Al-

though there were no reported cases of ureteral injury during attempted stent placement, the benefit of stent placement should be carefully weighed against the possible risks of ureteral injury and prolonged anesthesia. In one study, a retrograde pyelogram was performed before and after reduction of a sliding inguinal hernia and a more normal course of the ureter was seen after the hernia was reduced (5). There was no further intervention required and the patient's hydronephrosis resolved after the hernia repair. The majority of patients had favorable outcomes. In nine (52.9%) of the cases, the authors reported that there was no ureteral injury and the patients recovered well (1-4, 7). In five (29.4%) of the cases, post-operative renal imaging was ordered in the form of ultrasound, CT scan or IVU; the patients who were imaged post-operatively were all found to have a more normal course of the ureter and stabilization and/or improvement of hydronephrosis. (5, 9, 10). However, in three (17.6%) of the cases, post-operative follow-up was not reported (6, 8, 11). In one of the patients imaged post-operatively the ureteral involvement was identified only after ureteral injury and the patient was found to have worsened hydronephrosis and renal atrophy (1), supporting the importance pre-operative identification of the ureter within the hernia sac.

While rare, it is important for surgeons to be aware of the possibility of ureteral involvement in inguinal hernias. Lack of awareness can lead to significant intra-operative and post-operative complications. The general surgeon should be suspicious of large indirect inguinal hernias that could contain ureters and obtain pre-operative imaging. A patient with hydronephrosis and renal failure as their presenting symptom and a large hernia should also undergo appropriate imaging to rule out intra-hernia ureter as the cause of hydronephrosis and renal failure. Pre-operative identification of a ureter within a hernia sac can allow for early involvement of a urologist and pre-operative planning to protect the ureter and renal function. Failure to identify ureteral involvement can lead to complications such as intra-operative injury, the need for re-operation, and irreversible renal damage (1). The primary role of the urologist is to assist the general surgeon in identifying and avoiding injury to the ureter. Pre-operative ureteral stent placement or retrograde pyelogram can help reduce the likelihood of ureteral injury or help identify ureteral injury should it occur.

In the unfortunate occurrence of an inadvertent ureteral injury, a urologist should be consulted and standard techniques for repair of the ureter should be implemented, such as uretero-ureterostomy or ureteral reimplantation, depending on the location of the injury. There should be an abundance of ureteral length available for repair as these ureters are often elongated. A stent should be placed at the time of repair if it was not placed previously. Rarely, nephrectomy can be performed in lieu of ureteral stenting or repair. This should be reserved for patients with limited or no renal function confirmed on a functional study such as lasix renogram, and symptoms such as infections or stones. Although salvaging the kidney may not contribute to overall renal function, there is significant morbidity associated with a more extensive procedure involving nephrectomy compared to herniorrhaphy alone. It is reasonable to perform nephrectomy or ureteral ligation in situations where there is minimal renal function and significant ureteral reconstruction would be necessary to return the ureter to a normal position.

Conclusion

In this literature review, all patients who had post-operative imaging without an intra-operative ureteral injury had improvement or stabilization of their hydronephrosis and a more normal course of the ureter [1, 5, 9, 10].

We conclude that identification and avoidance of injury of a ureter contained within a hernia sac are paramount for prevention of ureteral injury during inguinal herniorrhaphies. This can be achieved by collaboration between the urologist and general surgeon and minimally invasive techniques such as pre-operative

ureteral stent placement for identification and protection of the ureter.

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