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Systematic Review

The emerging role of laparoscopic nephrectomy in the operative management of renal trauma: is less really more?

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ABSTRACT

The role of laparoscopic nephrectomy (LN) is well established in the operative armamentarium of renal surgery and has also extended to the resection of benign and malignant renal neoplasms. Despite growing evidence advocating conservative management of renal trauma, the role of LN in the management of renal trauma is not well defined. Thus, a systematic review was conducted to better define the role of LN in the subgroup of renal trauma patients requiring operative nephrectomy. In accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines, a comprehensive literature search was performed (March 2020), using the following databases: Cochrane library of systematic reviews, EMBASE, PubMed, Scopus, and web of science. Included studies were further assessed for relevance and quality using the Oxford 2010 critical appraisal skills program (CASP). A total of 620 studies were identified, non-relevant and non-English articles were excluded which resulted in 4 relevant articles being included. Due to a relative lack of data, case reports and case series were also included. The role of LN is a viable option in a select group of cases when operative intervention is already planned for advanced renal injury. The special considerations and relative contraindications to laparoscopy must be adhered to when selecting this modality in the setting of renal trauma. Future prospective studies are required to better define this relationship.

Keywords: LN, Renal trauma, Kidney trauma, Emergency, Minimally invasive surgery

INTRODUCTION

The earliest described laparoscopic intervention was performed in 1942 when Stone et al used this modality to demonstrate internal hemorrhage of a patient following a traumatic injury.[1] Skills development and technological advancements have enabled laparoscopic surgery to become a mainstay of diagnostic and therapeutic interventions within many of the surgical disciplines.[2] However, the role of laparoscopy in a trauma setting is still obscure, and not very well defined in the literature.[3,4] Used diagnostically (in select patient groups), laparoscopic interventions may result in fewer negative exploratory laparotomies, shorter hospital length of stay and improved patient outcomes.[5,6] Laparoscopic surgical exploration is operator dependent and may result in the missed injuries, in particular hollow viscus injuries.[2,7,8]

LN is a well-established modality of treatment for both benign and malignant pathological lesions of the kidney.

Precise role and outcome of LN in cases of renal trauma has been poorly defined. This systematic review aims to better define the utility of LN in setting of renal trauma.

METHODS

Search strategy

To illustrate role of LN, a search strategy was developed and conducted using an electronic database search. The following search terms were used 'LN and renal trauma' and 'LN and kidney trauma'. The following databases were searched: Cochrane database of systematic reviews, EMBASE, PubMed, Scopus, and web of science (March 2020). Cited reference lists of articles identified were further evaluated for potential additional inclusive studies. Language restriction was not applied.

Study selection

Articles included in the review were required to meet the following criteria: i) peer reviewed ii) full text was available and iii) clinical publications that related to the topic. Due to a lack of available data, case reports and case series were not excluded.

Data extraction and methodological quality evaluation

The PRISMA guidelines were adhered to during the search.[9] After the search was performed, all authors collectively assessed the articles based on the inclusion criteria stated above. The studies were assessed and ranked using the CASP (Table 1).[10] The reviewers collectively compiled a descriptive narrative for each study. The points of interest were tabulated (for each study). These included: region of study origin, sample size, median age, number of surgeons, renal grade, concomitant injuries, mechanism of injury, delay to surgery, operative duration, operative approach, length of hospital stay, adjunctive use of angiographic embolization and authors' conclusion/s (Table 2). Differences, disagreements, and conflicting entries were resolved by consensus amongst the reviewers.

RESULTS

The electronic search generated 620 articles; 367 articles were found to be duplicates. Of remaining 253 articles breakdown were as follows: Cochrane database of systematic reviews (6), EMBASE (16), PubMed (175), Scopus (36), and web of science (20). All non-English articles, letters to editors and irrelevant articles were excluded (249). 4 articles that included were included in final review.

Design of included studies: 3 articles were case reports and 1 was a case series.[11-14]

Region of study origin: Included studies were conducted in Australia, Italy, India and China.[11-14]

Sample size

Three studies only reported on one patient as they were case reports, and one study conducted by Wang et al reported on three patients.[11-14]

Age range of study subjects

The age of patients in the three case reports were 24-years, 21-years and 13-years, whereas the mean age of patients in the case series article was 37 years.[12-15]

Number of surgeons

3 studies reported that a single surgeon performed during LN, while 1 study didn't specify no. of surgeons.[11-14]

Renal grade

Three studies reported a grade 4 renal injury amongst sample, whereas Gidaro et al reported a grade 5 renal injury.[11-14]

Concomitant injuries

Two studies did not specify the presence or absence of other concomitant injuries.[11,14] Gidaro et al described a concomitant liver injury and Valsangkar et al reported both liver and splenic injuries.[12,13]

Mechanism of injury

2 case reports reported a motorcycle accident as mechanism of injury, while 1 reported fall from bicycle. The mechanism of injury in the three patients described in the case series was a low speed fall, post extracorporeal wave lithotripsy and a motor vehicle accident respectively.[12-15]

Delay to LN post traumatic incident

The delay to LN after traumatic incident was reported as within 24 hours for all 3 patients that were included in case series by Wang et al.[14] In 3 case reports, delay was reported as 91 days, 5 days and 1-2 days respectively.[11-13]

Operative duration

The operative duration varied greatly amongst studies, the shortest was 80 min in 3rd patient that was included in the case series by Wang et al and the longest was 270 min. Valsangkar et al didn't outline op duration.[11,13,14]

Duration of hospital stay

Among the three studies that reported this, the duration of hospital stay ranged between 5-7 days.[11,12,14]

Table 1: Details of CASP (Oxford: critical appraisal skills program) tool that was used to assess the studies included for review.

S no.	Questions	Siddins[11]	Gidaro[12]	Valsangkar[13]	Wang[14]
1	Did the study address a clearly focussed issue?	Y	Y	Y	Y
2	Was the cohort recruited in an acceptable way?	CT	CT	CT	CT
3	Was the exposure accurately measured to minimize bias?	CT	N	CT	CT
4	Was the outcome accurately measured to minimize bias?	CT	Y	CT	Y
5a	Have the authors listed all confounding factors?	Y	CT	N	Y
5b	Have the authors taken account of all the confounding factors?	Y	N	N	N
6a	Was the follow-up complete enough?	CT	CT	CT	CT
6b	Was the follow-up long enough?	CT	CT	CT	CT
7	Do you believe the results?	Y	Y	Y	Y
8	Can the results be applied to a local population?	N	N	N	Y
9	Do the results of the study fit with other available evidence?	Y	Y	Y	Y

Y-Yes; CT- Cannot tell; N-No

Table 2: Summary of literature included in the systematic review.

Author, Year	Article type	Region of study origin	Sample size	Age (yrs)	Single surgeon	Renal injury grade	Concomitant injuries	Mech of Injury	Time to surgery post trauma	Op-duration	Op approach	Duration of hospital stay	Adjunctive angio-graphic embolization	Authors' Conclusion/s
Siddins, 2001[11]	Case report	Aus	1	24	Yes	4	NS	Fall from bicycle	91 days	270 mins	Trans-peritoneal	5 days	NS	Caution in previous history of renal trauma
Gidaro, 2008[12]	Case report	Italy	1	21	Yes	5	Liver	Motor-cycle accident	5 days	130 mins	Trans-peritoneal	6 days	Yes	Laparoscopic nephrectomy could be an option in selected patients
Valsangkar 2017[13]	Case report	India	1	13	Yes	4	Liver, splenic collection	Motor-cycle accident	1-2 days	NS	Trans-peritoneal	NS	NS	Pre-operative case selection is important
Wang, 2014[14]	Case series	China	3	*37	NS	4	NS	Patient 1: low speed fall, 2: Post extracorporeal wave lithotripsy 3: MVA	Within 24 hours	Patient 1: 130 mins Patient 2: 110 mins Patient 3: 80 mins	Retro-peritoneal	Patient 1: 6 days Patient 2: 5 days Patient 3: 7 days	Yes	Laparoscopic nephrectomy is safe and feasible for a select group of patients

NS- Not Specified, *mean value.

Adjunctive angiographic embolization

Two studies did not specify whether adjunctive angiographic embolization was performed or not, whereas Gidaro et al and Wang et al stipulated the use of angiographic embolization.[11-14]

DISCUSSION

The kidney is one of the most common solid organs that prone to injury post trauma. Most renal injuries are secondary to blunt abdominal trauma but may also result from penetrating trauma after high velocity deceleration trauma. The injury is graded based on imaging findings which correlate to morbidity, mortality as well as the likelihood for surgical intervention. Renal injuries seldom occur in isolation, hence overall management is dependent on the presence of other concomitant injuries.[16,17]

In general, low grade renal injuries (grade 1-3) in patients that are hemodynamically stable are managed conservatively. Hemodynamically stable patients with grade 4 and 5 renal injuries being managed conservatively require frequent reassessment and repeat imaging within 36-48 hours.[18] Indications for surgical intervention include persistent life-threatening hemorrhage, an expanding pulsatile retroperitoneal hematoma, traumatic pelvi-ureteric junction avulsion and the presence of coexisting bowel or pancreatic injury that may be associated with a high grade renal injury.[16,17]

Secondary hemorrhage from pseudoaneurysm or arteriovenous malformation can be managed by arteriography and embolization in most cases to avoid the need for open surgery.[16] In some cases preoperative angiographic embolization may not be successful in controlling blood loss however, it may still reduce the risk of intraoperative secondary haemorrhage.[19]

Postulated indications for LN included high grade injuries with persistent blood loss post embolization, hypertension secondary to trauma not responding to medical management and a symptomatic patient with an associated non-viable kidney.[11-13,20] General contra-indications as with other laparoscopic interventions include hemodynamic instability, head injury, retinal detachments, coagulopathy and multiple organ involvement.[1,21-23] Other specific contraindications include previous renal or retroperitoneal surgery, pyonephrosis, xanthogranulomatous pyelonephritis, renal tuberculosis, significant haemorrhage within Gerotas fascia (as it obliterates the fascial planes), penetrating renal injuries, other abdominal organ injuries and hematoma larger than 10-12 cm or hematoma more likely to rupture intraoperatively.[1,7,16,17]

The LN approach can either be transperitoneal or retroperitoneal. Advantages of a transperitoneal approach affords the surgeons the ability to inspect the abdominal cavity and simultaneously treat concomitant injuries as well as control of the renal artery without disruption of the hematoma.[2,7,8] However, with the transperitoneal approach the intraoperative duration may be prolonged as it necessitated mobilization of colon or duodenum.[14]

During LN, it is important to identify and manage complications early, which may even necessitate conversion to an open procedure. Potential complications of LN include missed injuries, tension pneumothorax, pneumomediastinum, gas embolism and secondary hemorrhage.[2,6,14] In the hands of a urologist or trauma surgeon skilled in laparoscopic surgery, LN may be advantageous over open nephrectomies due to shorter duration of recovery time, smaller incision site, reduction in blood loss and an overall shorter duration of hospital stay.[24]

Based on the findings of this systematic review and conclusions of the studies reviewed, the role of LN in renal trauma has been explored in a limited fashion with favourable results when performed in carefully selected cases.[11-14] General trauma related principals still apply, and surgeons need to be cognisant of contra-indications.

CONCLUSION

Although the increasing trend of conservative management is now commonplace in cases of advanced renal grade trauma, the role of LN is a viable option in the select group of cases when operative intervention is planned for advanced renal injury. Future prospective studies are needed to better define this relationship. The special considerations and contra-indications relating to laparoscopic intervention in general are still relevant.

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