

Management of High-grade Blunt Renal Trauma

Min A Lee, M.D., Myung Jin Jang, M.S., Gil Jae Lee, M.D.

Department of Trauma Surgery, Gachon University Gil Medical Center, Incheon, Korea

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Correspondence to

Gil Jae Lee, M.D.

Department of Trauma Surgery, Gachon University Gil Medical Center, 21 Namdong-daero 774beon-gil, Namdong-gu, Incheon 21565, Korea

Tel: +82-32-460-3010

Fax: +82-32-460-2372

E-mail: nonajugi@gilhospital.com

Purpose: Blunt injury accounts for 80-95% of renal injury trauma in the United States. The majority of blunt renal injuries are low grade and 80-85% of these injuries can be managed conservatively. However, there is a debate on the management of patients with high-grade renal injury. We reviewed our experience of renal trauma at our trauma center to assess management strategy for high-grade blunt renal injury.

Methods: We reviewed blunt renal injury cases admitted at a single trauma center between August 2007 and December 2015. Computed tomography (CT) scan was used to diagnose renal injuries and high-grade (according to the American Association for the Surgery of Trauma [AAST] organ injury scale III-V) renal injury patients were included in the analysis.

Results: During the eight-year study period, there were 62 AAST grade III-V patients. 5 cases underwent nephrectomy and 57 underwent non-operative management (NOM). There was no difference in outcome between the operative group and the NOM group. In the NOM group, 24 cases underwent angioembolization with a 91% success rate. The incidence of urological complications correlated with increasing grade.

Conclusions: Conservative management of high-grade blunt renal injury was considered preferable to operative management, with an increased renal salvage rate. However, high-grade injuries have higher complication rates, and therefore, close observation is recommended after conservative management.

Keywords: Trauma; Kidney injury; Therapeutic embolization; Conservative treatment

INTRODUCTION

Renal injury occurs in up to 5% of trauma patients, and accounts for 24% of traumatic abdominal solid organ injuries [1]. Blunt injury accounts for 80 to 95% of renal injury trauma in the United States [2]. The majority of blunt renal injuries are low grade and 80 to 85% of these injuries can be managed conservatively [3]. In recent years, non-operative management (NOM) has been reported as safe and effective, even in hemodynamically unstable high grade renal injury patients in some literature [4]. However, there is still debate over the management of high-grade renal injury patients. We reviewed our experience of renal trauma at our trauma center in order to assess management strategy for high grade blunt renal injury.

METHODS

We reviewed blunt renal injury cases admitted at a single trauma center between August 2007 and December 2015. Data were collected from chart review and included patient age, gender, injury mechanism, site of injury, grade of injury, the injury severity score (ISS), vital signs, laboratory data, complications, treatment options, and length of hospital stay.

Renal injury was diagnosed from history, symptoms, and physical and radiologic examinations. All patients underwent contrast-enhanced computed tomography (CT) at ER admission. On CT, renal injury was classified according to the American Association for the Surgery of Trauma (AAST) organ injury scale.

Among renal injury patients, cases of high-grade renal injury (AAST grades III, IV, and V) were included in the analysis. Patients with thrombotic injury in the renal artery with renal infarction or patients who had underlying renal disease, such as polycystic kidney disease, were excluded. Since 2010, a radiologist has been recruited and a trauma surgeon has made a decision about renal injury. Therefore, we compared the changes in the treatment methods before and after 2010. Statistical analysis was performed using Sigmasat software version 2.0 (IBM Corp., Armonk, NY, USA).

RESULTS

During the eight-year study period, of the 139 patients with traumatic blunt renal injury, 31 were grade I, 46 were grade II, 24 were grade III, 31 were grade IV, and 7 were grade V. We analyzed 62 high-grade patients (AAST III-V). Of these patients, 33 had injury on the right side, 27 on the left, and 2 patients had bilateral renal injury. Mean ISS was 19 (Table 1).

Five patients underwent immediate exploratory laparotomy, endovascular embolization was performed in

Table 1. Demographics and clinical presentation

| Variable | Value |
|--------------------|-----------|
| Number of patients | 62 |
| Gender | |
| Female | 32 (33.9) |
| Male | 41 (66.1) |
| Mean age (years) | 39.7 |
| Grade | |
| III | 24 (38.7) |
| IV | 31 (50.5) |
| V | 7 (11.3) |
| Site | |
| Left | 27 (43.5) |
| Right | 33 (53.2) |
| Bilateral | 2 (3.2) |
| Mean ISS (range) | 19 (4-41) |
| Management | |
| Operation | 5 (8.1) |
| Angioembolization | 24 (38.7) |
| Observation | 33 (53.2) |

Values are presented as number (%) unless otherwise indicated. ISS: injury scaled score.

Table 2. comparison of outcomes

| Variables | Operation (n=5) | NOM (n=57) | p-value |
|---------------|-----------------|------------|---------|
| Complication | 1 (20) | 12 (21) | 0.956 |
| ICU stay | 5.8±5.0 | 6.2±9.3 | 0.553 |
| Hospital stay | 19.6±18 | 26.3±17.6 | 0.124 |
| Mortality | 0 (0) | 0 (0) | |

Values are presented as mean±standard deviation or number (%). NOM: non-operative management, ICU: intensive care unit.

Table 3. Urologic complication by grade

| | No. by grade | | |
|----------------------------|--------------|---------|-------|
| | III (24) | IV (31) | V (7) |
| Urinary leakage | - | 1 | 3 |
| Bleeding | 1 | 1 | 1 |
| Hydronephrosis | - | 2 | - |
| Pseudoaneurysm | - | 2 | - |
| Abscess | - | 1 | - |
| Renal failure | 1 | - | - |
| Total | 2 | 7 | 4 |
| Complication rate by grade | 8.3% | 22.6% | 57.1% |

24 patients, and 33 patients underwent observational management. Therefore, 57 patients of high grade renal injury underwent non-operative management (NOM), consisting bed rest and monitoring of vital signs and hematocrit levels. Endovascular embolization was performed in patients who had persistent or delayed bleeding but hemodynamically stable. Five patients underwent nephrectomy. These cases were hemodynamically unstable with renal hemorrhage and underwent exploration and nephrectomy.

No mortality related to renal injury in either the operative group or the NOM group occurred. On comparison of outcomes, there were no differences between operative and NOM group in terms of complications and length of intensive care unit (ICU) or hospital stay (Table 2). Complications associated with renal injury occurred in 13 patients (20%): four patients had urine leakage (6.5%); three had delayed bleeding (4.8%); two had hydronephrosis (3.2%); two had pseudoaneurysm (3.2%); one patient had an abscess; and one had renal failure. The Incidence of urological complications correlated with increasing grade (grade III=8.3%, grade IV=22.6%, and grade V=57.1%; $p=0.021$) (Table 3).

DISCUSSION

Over the past few years, the management of traumatic blunt renal injury has changed from operative exploration to NOM [5]. While NOM of blunt renal injuries is established, NOM of high-grade renal injuries remains contro-

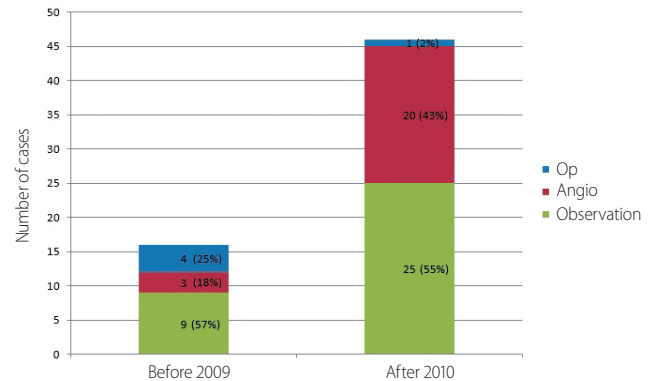


Fig. 1. Severe blunt renal injury management strategies.

versial [3].

Peters and Bright reported that the rate of delayed nephrectomy after conservative management was 14.6% and that conservative management resulted in a longer hospital stay [6]. Husmann et al. suggested that renal exploration and surgical repair improved prognosis [7].

Danuser et al. reported that primary conservative management of blunt kidney rupture was related to less blood loss and damage to the renal parenchyma compared to patients treated with initial surgery [8]. Wessells et al. reported that renal preservation could lead to improved outcomes compared to nephrectomy [9].

In our study, emergency surgery was performed in five cases (8.1%) of traumatic blunt renal injury. Among emergency operations, four cases were performed before 2009. They were hemodynamically unstable on ER admission. After resuscitation, they maintained a systolic blood pressure of 90 mmHg or more; however, exploratory laparotomy and nephrectomy were performed in cases of sustained ongoing bleeding within 24 hours. Exploration was determined based on the surgeon’s preference or availability of angiography. After 2009, high-grade renal injury with ongoing bleeding was managed conservatively in most cases. Comparing before and after 2009, the observation management rate had not changed; however, angioembolization ratio had increased (Fig. 1). Improvements in resuscitation management of trauma patients changed the concept of NOM in high-grade renal injury and highly-selective embolization skills shifted the treatment strategy toward NOM in severe blunt renal trauma patients [10-12]. Angioembolization was performed in cases of extravasation on abdominal/pelvic CT or of sus-

pected ongoing bleeding.

In both the operative and NOM groups, no mortality was related to renal injury. The incidence of complication, and length of ICU or hospital stay showed no significant differences between the two groups (Table 2).

In a series of 26 patients with grade IV-V blunt renal injury, Bozeman et al. found no statistically significant difference in morbidity between operative and non-operative group [3]. Altman et al. reported that patients managed conservatively had less morbidity [10]. Brewer et al. successfully managed unstable grade V patients by percutaneous embolization [4].

An adaptive indication of operation for blunt renal injury is continuing hemodynamic instability owing to renal hemorrhage unresponsive to aggressive resuscitation [1]. Primary conservative management is the treatment option even for high-grade injury in resuscitation patient.

Complications increased with the grade of injury rather than the initial treatment method, and were detected on routine follow-up CT. We performed routine follow up imaging approximately seven days after blunt renal injury. Blankenship et al. recommended follow-up CT after 48 hours in AAST grade IV-V renal injury patients or patients with clinical signs of complications [13]. Malcolm et al. stated that routine follow-up imaging is unnecessary in blunt renal injury of grades I-III [14] because it did not alter clinical management [1].

Almost all complications were managed by percutaneous drainage, retrograde stent placement. Among grade V patients, one patient had massive urine leakage at the level of the renal pelvis and one had persistent urine leakage over 19 days, despite retrograde stent placement, and the need for nephrectomy was considered. As a result, two grade V injury patients underwent delayed nephrectomy. There were seven grade V injury patients, of whom one underwent emergency nephrectomy. Ureteropelvic junction avulsion and laceration of the renal pelvis require surgical repair [15]. Urine leakage can be managed with stent placement for four to six weeks [16]. The renal failure patient was older and had severe associated injury (ISS 29), and, therefore, could not recover from acute kidney injury as a result of initial hemodynamic shock.

As a result, in 88% of high-grade blunt renal injury (grade III-V) patients and 57% of grade V injury patients,

the kidney was salvaged. There were seven grade V injury patients, one of whom underwent emergency nephrectomy. Two of the remaining six cases underwent delayed nephrectomy owing to urinary leakage. Primary NOM resulted in a more than 50% renal salvage rate in grade V renal injury patients.

CONCLUSION

Conservative rather than operative management is preferred in high-grade blunt renal injury. This is due to improvements in the resuscitation therapy quality of trauma surgeons and the development of highly selective angioembolization. However, there is an increased complication rate in high-grade injuries, and close observation is recommended for high-grade renal injury after conservative management.

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