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Pulmonary embolisms and infections after renal trauma

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ABSTRACT

INTRODUCTION. The objective of this study was to describe and evaluate the management of patients with renal trauma and their complications at the Department of Urology at Aarhus University Hospital (AUH), Denmark.

METHODS. All patients diagnosed with renal injury due to trauma and with contact to the Department of Urology at the AUH, Denmark, between March 2016 and March 2021 were included. Patients were identified by the International Classification of Diseases, Tenth version, code and data obtained from electronic patient records.

RESULTS. A total of 58 patients were identified. The median age was 33 years (7-95 years) and the median length of hospitalisation was five days (range: 0-52 days). All patients were evaluated with a multiphase computed tomography upon admission. Injuries to the kidney were graded using the American Association for the Surgery of Trauma kidney injury scale. Twelve percent had grade I injury, 26% had grade II injury, 26% had grade III injury, 36% had grade IV injury and 3% had grade V injury. In the acute phase, all patients were managed non-operatively. Early complications were found in 24% of patients. Pulmonary embolism was diagnosed in 7%. Furthermore, 7% had an infection as a late complication and all of these patients had also had an early infection. A total of 60% were followed up with a renal-scintigraphy three months after their renal trauma. This examination had no consequence for any of the patients.

CONCLUSIONS. No patients died due to the renal trauma. However, many experienced complications in terms of infections and pulmonary embolisms. These data support earlier findings and suggest that a renal scintigraphy after renal traumas may be obsolete.

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Knowledge of the management and potential complications in patients with renal trauma is important for all urologists. Renal trauma is only described in ~ 5% of all trauma cases [1-3]. This is probably due to the well-protected placement of the kidneys in the retroperitoneal cavity. There is a male predominance of ~ 3:1 in patients suffering from renal trauma [3].

Renal trauma is classified according to the American Association for the Surgery of Trauma (AAST) Renal Injury Grading Scale into grades I-V [4] (**Table 1**). The evaluation of patients is typically based on a trauma protocol CT, unless an emergency laparotomy is performed. The AAST classification of the renal injury is a predictor of morbidity and intervention [5].

TABLE 1 American Association for Surgery of Trauma, Renal Injury Grading Scale.

Grade	CT findings
I	Subcapsular haematoma and/or parenchymal contusion without laceration
II	Perirenal haematoma confined to Gerota's fascia Renal parenchymal laceration ≤ 1 cm depth without urinary extravasation
III	Renal parenchymal laceration > 1 cm depth without collecting system rupture or urinary extravasation Any injury in the presence of a kidney vascular injury or active bleeding contained within Gerota's fascia
IV	Parenchymal laceration extending into the urinary collecting system with urinary extravasation Renal pelvis laceration and/or complete ureteropelvic disruption Segmental renal vein or artery injury Active bleeding beyond Gerota's fascia into the retroperitoneum or peritoneum Segmental or complete kidney infarction(s) due to vessel thrombosis without active bleeding
V	Main renal artery, vein laceration or avulsion of hilum Devascularised kidney with active bleeding Shattered kidney with loss of identifiable parenchymal renal anatomy

Grade I-III injuries are managed conservatively, and more evidence now supports also managing grade IV injuries conservatively if they are haemodynamically stable [2, 4]. Penetrating injuries, unstable patients and grade V injuries often require surgical intervention. However, expectant management is supported for some patients with grade V blunt trauma. The treatment modality will also differ between centres, as selective angioembolisation is not available in all centres.

If surgery is necessary, a transperitoneal approach should be adopted [2]. If a stable haematoma is detected in a patient with other injuries, the haematoma should not be opened [2]. Surgical repair of vascular injuries is rarely successful and nephrectomy is a safer choice [6].

The aim of this study was to describe and evaluate the management of patients with renal trauma and their complications at the Department of Urology, Aarhus University Hospital (AUH), Denmark, during a five-year period. AUH is located in the Central Denmark Region and serves more than 800,000 citizens. AUH is the only hospital in the region with capacity for conducting angioembolisation. Patients with a potential need for selective angioembolisation will therefore be transferred to AUH and included in this study population.

Patients involved in traumas are admitted to the emergency department. They are evaluated and examined with a trauma protocol CT and, after stabilisation, they are transferred to the relevant department or discharged from the emergency department.

METHODS

All patients diagnosed with renal trauma and with contact to the Department of Urology at the AUH, Denmark, between March 2016 and March 2021, were included. This included patients evaluated by a urologist or admitted to the department. Patients were identified retrospectively by the International Classification of Diseases, Tenth version (ICD-10) code DS370, and data were obtained from the electronic patient records. Patients with iatrogenic renal trauma were excluded. Complications were categorised as late (> 30 days) or early (≤ 30 days). The minimum follow-up period after renal trauma was three months. Data were recorded in RedCap, an online data capture system, and graphs were designed in Stata. Data collection was approved by the AUH hospital

management.

Data are displayed as medians with range.

Trial registration: not relevant.

RESULTS

Patients

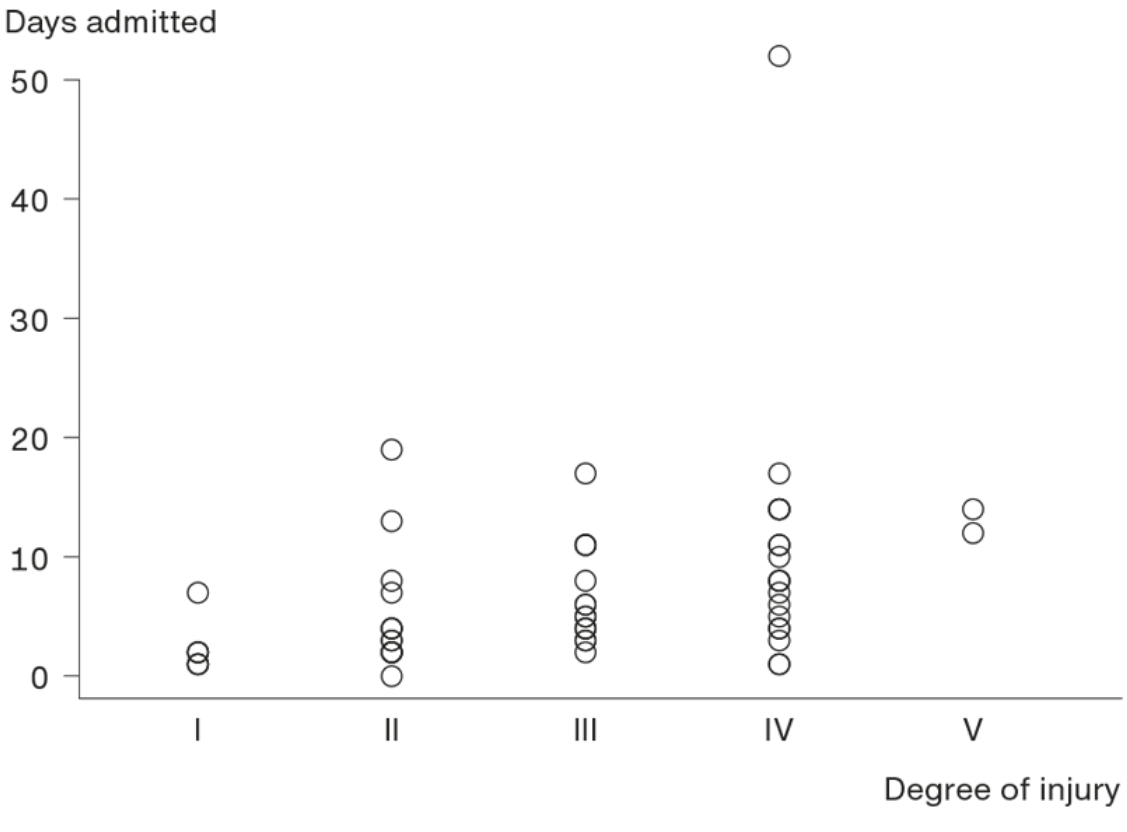
A total of 58 patients were identified. The median age was 33 years (range: 6-95 years). For men (42 patients), the median age was 30 years (range: 11-90 years); and for women (16 patients), the median age was 54 years (range: 6-95 years). The median length of hospitalisation was five days (range: 0-52 days). All patients were evaluated with contrast-enhanced CT upon admission, following the local trauma protocol.

A total of 38 patients (66%) presented with macroscopic haematuria upon admission, seven did not display haematuria and for the remaining 13 patients this information was not recorded in the patient file.

Injury

All patients, except one, had been exposed to blunt trauma. Injuries to the kidney were graded using the AAST kidney injury scale, and the data are presented in **Figure 1** by length of hospital stay.

FIGURE 1 Degree of trauma by days hospitalised.



For older patients, a majority were low-energy traumas, mostly fall accidents at home. Among younger patients most were high-energy traumas (i.e. traffic accidents) and sporting accidents (**Figure 2**).

FIGURE 2 Mechanism of injury. “LowE” represents low-energy trauma, i.e. falling from same heights, no force applied from other people or machines. "Sport" includes biking, skiing and motocross accidents. The category “Ebriated” covers accidents where the patient was under the influence of alcohol. “Play” is traumas caused by accidents in the school yard or on a playground. “HighE” is traumas caused by high-energy trauma, such as traffic accidents and work accidents with heavy machinery.

A total of 29 patients (50%) suffered from other traumas, most commonly spleen trauma (ten patients) and rib fractures (13 patients).

Management

All patients were managed non-operatively, although one patient underwent a nephrectomy at a later state due to a chronic infection. Nine patients (16%) received a selective angioembolisation due to an active arterial bleeding, and 17 patients (30%) had a JJ stent inserted.

Twenty-three patients (40%) were given compression stockings, and 16 patients (28%) were administered low-molecular heparin to decrease the risk of thromboembolism during bedrest. The median length of stay of these patients was twice that of the remaining patients: 11.5 days (range: 4-52 days).

In all, 31 patients (53%) received antibiotics during hospitalisation, and 20 patients (34%) also received antibiotics after discharge.

Complications

Early complications (within 30 days after injury) were described in 24% (n = 14) of patients in the form of infection (including abscess), urinoma, haematuria and pulmonary embolism.

A patient was defined as infected if there were signs of infection in the blood work (increase in C-reactive protein and white blood count) and/or fever. These findings were interpreted by the clinician overseeing the patient as signs of infection. In 7% (n = 4) of the patients, a pulmonary embolism was diagnosed. Four patients (7%) had an infection as a late complication, and all of these patients had suffered from an infection shortly after their trauma. One patient died due to rhabdomyolysis, but no patients died directly in relation to their renal trauma.

Readmission was necessary for seven patients; in three patients due to pain and haematuria, in four patients due to infection. The patients with haematuria and pain were admitted shortly after discharge (no more than seven days). The patients readmitted for infections were admitted up to months after their trauma.

The patients diagnosed with pulmonary embolism were all females, and they had high-grade injuries (one grade III, one grade IV and two grade V injuries). Three of the patients were diagnosed by coincidence, since no symptoms of pulmonary embolism were recorded. The CT revealing pulmonary embolism was performed for other reasons (abdominal pain caused by a large haematoma, before planning a percutaneous bilateral nephrostomy, and as a follow-up on a pseudoaneurism). All four patients had a long hospital stay (range: 12-52 days).

Patients with complications had grade III-V injuries, predominately grade IV injuries. All seven patients received antibiotics during their hospital stay, and five were also discharged with antibiotics. Four had JJ stents, three were treated with selective angioembolisation. The median hospitalisation period was 12 days (range: 6-17 days).

Follow-up

A total of 60% (n = 35) had a renography three months after the renal trauma. This examination had no immediate consequence for any of the patients.

DISCUSSION

Complication rate

We identified 24% of patients with early complications after the renal trauma. Infections were the most frequently described complication. However, four patients were randomly diagnosed with pulmonary embolism. A total of 33 patients had a JJ stent inserted due to urinary extravasation. A 24% complication rate is high. This may be explained by higher grade traumas, discrepancies in definition of “complication” or “infection” as discussed in the following.

A total of 62% of our patients had a renal trauma classified as grade III or higher. In our data, an overrepresentation was observed of high-grade renal injuries compared with other series because lighter traumas can be discharged directly from the emergency department and may therefore not have come into contact with the urology department. Furthermore, the high-grade injuries with potential need of selective angioembolisation were transferred from another hospital. This will influence the length of hospitalisation and probably also the complication rate.

Bukur et al. reported a 1.8% complication rate in non-operative management of blunt kidney trauma patients [7].

However, their complication rate was based solely on CT follow-up. Many of our patients had an infection diagnosed by clinical observation and blood tests.

In Maibom et al. [1], signs of infections were treated with antibiotics and if they responded to treatment, the infection was not recorded as a complication [1]. In our cohort, patients who developed fewer and were treated as having an infection were recorded as having a complication. This may potentially lead to an overrepresentation of "infection complications" since retroperitoneal haematoma without bacterial infection may cause the same symptoms.

In the article by Maibom et al. [1], 7% (five patients) were readmitted due to infections, which, at that point, were considered complications. This is comparable to our 7% (four patients) who were readmitted with infections. Our complication rates are higher. However, the patients in our report were registered as having a complication if they had an infection even if it responded to antibiotics. Complication rates were similar to ours in an American study [7]. In this study, both sharp and blunt trauma were included, 71% of patients were grade I-III, which is comparable to our population with 64% grade I-III injury [7].

Ureteral stents

Chebbi et al. conducted a retrospective multicentre study, reporting that late drainage by ureteral stent versus early drainage had the same number of persisting urinary extravasations [8]. According to the European Association of Urology (EAU) guidelines, stenting or drainage should be performed after repeat imaging if persisting urinary leakage is observed in patients with grade IV-V trauma [2], supporting the findings of Chebbi et al. [8]. In a Danish report by Maibom et al. [1], only 5% of the cases were treated with a JJ stent. They included kidney trauma patients admitted to other wards. The observation and management of these patients might differ from that of patients in a urology department due to a different focus, knowledge and training among doctors and nurses alike. They reported 63% admitted to the urology department, whereas the remaining patients were admitted to other wards. Comparison will be challenged by this. However different approaches to observation and management cannot explain the entire difference.

In this report, we recorded a high rate of JJ stents; 30% of patients received a JJ stent during recovery after their renal trauma. In our department, we conducted repeat CT with a delayed phase to identify collecting system/ureteric injury if an increase is observed in serum creatinine, if the patient has worsening of pain or has symptoms of infection (biochemically or clinically). The high rate of JJ stents may potentially increase the risk of infection. Both the placement of the stents and having a foreign body inserted may increase the subsequent risk of infection. Therefore, JJ stent indications should be considered carefully.

Renal scintigraphy

Renal scintigraphy is recommended in the EAU guidelines as a long-term follow-up to identify areas of scarring, functional loss or obstruction [2]. Renal scintigraphy as a three-month follow-up did not trigger any treatment or further follow-up. It might therefore be argued that the procedure is obsolete. Maibom et al. [1] found similar results in their study and suggested that scintigraphy had no clinical consequences for patients without ureteric injury.

However, if a patient encounters kidney disease later in life, the treatment of this disease may be influenced by the "baseline kidney function" after the trauma. If a renal scintigraphy serves this purpose alone, it should, perhaps, be offered to selected patients. Determining the criteria for selection of these patients falls beyond the scope of this paper.

It may be speculated that some trauma patients may have been admitted to other departments without involvement of a urologist. For example, major unstable traumas with major bleeding from other organs. This

would possibly also account for the surprisingly few penetrating traumas recorded, since these are likely to be in this group of unstable trauma patients. Such traumas are very likely to have been missed in this retrospective study. Patients with a low grade renal trauma will also very likely have been missed in this study, since the renal trauma may not be registered unless a urologist was contacted.

Pulmonary embolism

To our knowledge, reports of incidence of pulmonary embolisms as a complication to renal trauma are scarce. A case report from Switzerland [9] reported a 71-year-old male with pulmonary embolism and pseudoaneurism following a grade IV blunt trauma. Three of four patients diagnosed with pulmonary embolism in our cohort were not diagnosed due to symptoms, which begs the question: Are we neglecting a complication to renal trauma and the following bedrest?

EAU guidelines [2] recommend compression stocking and low-molecular weight heparins (LMWH) to patients on bedrest. The risk of rebleeding due to antithrombotic medication is considered low [2]. The administration of early LMWH (≤ 3 days) is not considered a greater risk than late administration (> 3 days) [10].

However, a systematic review found no decrease in mortality after thomboprophylaxis, although they did find a decrease in deep vein thrombosis [11].

CONCLUSIONS

All patients were initially managed non-operatively, one patient with grade IV injury underwent nephrectomy at a later stage due to persistent infection.

No patients died as a direct consequence of their renal trauma. However, many experienced complications in terms of infections and pulmonary embolisms. All late infections were preceded by early infection - a focus point when treating these patients. Patients treated for infection in relation to their kidney trauma are at a higher risk of late infections and may potentially benefit from follow-up either in an out-patient clinic with blood samples and clinical evaluation or by their family doctor.

A total of 7% of patients were diagnosed with pulmonary embolism. Symptoms of pulmonary embolism should therefore be a focal point when observing patients with renal trauma. The risk of thromboembolism due to bedrest should be considered when determining the length of bedrest. Antithrombotic medication is recommended even if evidence of the effect of thromboprophylaxis on mortality is scarce.

These data support earlier findings and suggest that a renography after renal traumas may be obsolete. We suggest that only patients diagnosed with grade III trauma or more should undergo follow-up renography.

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REFERENCES

1. Maibom SL, Holm ML, Rasmussen NK et al. Renal trauma: a 6-year retrospective review from level 1 trauma center in Denmark. Scand J Urol. 2019;53(6):398-402.

2. European Association of Urology. Urological trauma guidelines. https://uroweb.org/guidelines/urological-trauma (8 Nov 2021).
3. Chouhand JD, Winer AG, Johnson C et al. Contemporary evaluation and management of renal trauma. Can J Urol. 2016;23(2):8191-7.
4. Petrone P, Perez-Calvo J, Brathwaite CEM Joseph DK et al. Traumatic kidney injuries: a systematic review and meta-analysis. Int J Surg. 2020;74:13-21.
5. Bryk DJ, Zhao LC. Guideline of guidelines: a review of urological trauma guidelines. BJU Int. 2016;117(2):226-34.
6. Knudson MM, Harrison PB, Hoyt DB et al. Outcome after major renovascular injuries: a Western trauma association multicenter report. J Trauma. 2000;49(6):1116-22. doi: 10.1097/00005373-200012000-00023.
7. Bukur M, Inaba K, Barmparas G et al. Routine follow-up imaging of kidney injuries may not be justified. J Trauma. 2011;70(5) 1229-33.
8. Chebbi A, Peyronnet B, Giwerc A et al. Observation vs. early drainage for grade IV blunt renal trauma: a multicenter study. World J Urol. 2021;39(3):963-9.
9. Gstrein L, Antwerpen I, Gissler HM et al. Renal pseudoaneuryms and pulmonary embolism: a unique manifestation of complications following blunt renal trauma. Urol Case Rep. 2019;24:100835. doi: 10.1016/j.eucr.2019.01.016.
10. Eberle BM, Schnüriger B, Inaba K et al. Thromboembolic prophylaxis with low-molecular-weight heparin in patients with blunt solid abdominal organ injuries undergoing nonoperative management: current practice and outcomes. J Trauma. 2011;70(1):141-6; discussion 147. doi: 10.1097/TA.0b013e3182032f45.
11. Barrera LM, Perel P, Ker K et al. Thromboprophylaxis for trauma patients. Cochrane Database Syst Rev. 2013;(3):CD008303. doi: 10.1002/14651858.CD008303.pub2.