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The outcome of non-operative management in high-grade renal trauma and related factor

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ABSTRACT

Background: Non-operative management (NM) is initially approached in renal trauma. Surgical exploration is required in high-grade (grade IV, V), however, the success rate challenging NM is increasing in recently reported.

Objectives: To review non-operative management strategy outcome in renal trauma and evaluative associated failure factors.

Materials and Methods: Retrospectively reviewed renal trauma patients between January 2008 – December 2015 including patients' demographics, injury mechanism, clinical characteristics, laboratory and imaging data. The outcome of management was recorded and analyzed the relating factors.

Results: 107 renal trauma patients were included in this study. 63.6% are Low-grade and high-grade renal trauma found 36.4% respectively. NM success rate at 82.2% in low-grade and 61.5% in high-grade group. Univariate analysis revealed hypotension, tachycardia, low hemoglobin (< 10 mg/dl) at present, high-grade renal trauma, and finding signs on computed tomography (CT) such as peri-renal hematoma ≥ 3.5 cm, parenchymal infarction, and intravascular extravasation were associated with failure non-operated. However, high-grade renal trauma is the only failure predictor of NM on multivariate analysis (odds ratio (OR) 13.01, 95% confidence interval (CI) 2.33 – 72.62; *P* = 0.003).

Conclusions: Most renal trauma is highly success with conservative treatment. Although the high-grade injury is the strongest non-operation failure factor, however, this management still feasible in clinically stable with the acceptable in short term outcome and challenge. For long term follow up outcome and complication, the further study and closed surveillance was needed

Keywords: non-operative management strategy, renal trauma, kidney injury, high-grade renal trauma

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Background

Traumatic abdominal injury occasion-nally involved genitourinary system, especially renal trauma occurred about 10%.[1] The kidney is the most commonly injured genitourinary organ in all ages and blunt injury is the most common mechanism from road traffic accidents, falls, and assault. The energy force cause injury leading contusion or laceration to renal parenchyma eventually extend-ed into collecting system and vascular pedicle. Penetrating injuries cause direct tissue disruption usually furthermore severe. The severity of renal injury commonly classified base on the American Association for the Surgery of Trauma (AAST) injury scale (Table 1).[2] These severity depend on abdominal computed tomography (CT) or direct renal exploration, low grade renal trauma are grade I-III and high-grade renal trauma are grade IV-V.[3,4] The morbidity and mortality rates of renal trauma vary on severity, associated injuries and utility of management.[4] Conservative management of renal trauma has been clearly demonstrat-ed an effective therapeutic option.[5] However, this strategy in high-grade renal injuries remains controversial especially grade IV injury.[6] According to surgical exploration in high-grade renal injury usually leads finalized with nephrectomy, therefore, current-ly recommendation that non-operative management in the mean-ing of no renal exploration were standard care for all low-grade renal traumas. Additionally, this approach is increasing published support possibility treat in grade IV or even grade V renal injury.[2,3,5] Nonetheless surgery remains a valid option in these certain situations following with the challenge on promptly identifying which patients should be treated surgically. We retrospectively review-ed management of renal trauma and evaluated related factors of failed non-operative management.

Materials and Methods

This hospital-based descriptive study conducted in Bhumibol Adulyadej Hospital, Bangkok, Thailand between January 2008 to December 2015. All renal injuries patients whose diagnosed and graded on computed tomography (CT) or identified during surgical abdominal exploration. In unstable trauma patients who need immediate abdominal exploration will define renal trauma on finding intra-operatively, if clearly renal scattering or deep renal laceration founded will define as high-grade whiles only stable hematoma or small laceration without hilum expanding hematoma will define as low grade renal injury as AAST in Table 1. The definition of non-operative management protocol in renal trauma includes all treatment strategies but no surgical renal exploration whose usually initiation with hemodynamic stabili-zation, serial hematocrit level as well as necessary laboratory and abdomi-nal examination then follow up with CT scan if clinical indicated.

Table 1 American Association for the Surgery of Trauma Renal Injury Grading Scale 2

Grade[a]	Injury Detail[b]	
I	Contusion	Microscopic or gross hematuria, urologic studies normal
	Hematoma	Subcapsular, non-expanding without parenchymal laceration
II	Hematoma	Non-expanding peri-renal hematoma confined to the renal retroperitoneum
	Laceration	< 1 cm parenchymal depth of kidney cortex without urinary extravasation
III	Laceration	> 1 cm parenchymal depth of kidney cortex without collecting system rupture or urinary extravasation
IV	Laceration	Parenchymal laceration extending through the kidney cortex, medulla and collecting system
	Vascular	Main renal artery or vein injury with contained hemorrhage
V	Laceration	Completely shattered kidney
	Vascular	Avulsion of renal hilum that devascularizes kidney

a : Advance one grade for multiple injuries to the same organ

b : Based on most accurate assessment at autopsy, laparotomy or radiologic study

This study was approved by institutional ethics committee. Electronic data base was collected, included demographics, mechanism, hemodynamic, hematuria, hemoglo-bin, serum creatinine, renal injury grade, computed tomography (CT) finding sings (medial renal parenchymal laceration, peri-renal hematoma ≥ 3.5 cm. and intravascular extravasation) was recorded accord-ing to these signs reflexed active bleeding and need urgent intervention in literature,1 blood transfusion, initial hospital management (immedi-ate laparotomy) and hospital stay.

Patients data were analysis related operative predictor. Continuous variables were reported as mean and standard deviation, categorical data documented as counts and propor-tions and elucidated analysis relating with chi-square test or Fisher exact test as appropriate. Multiple logistic regression define independent predic-tors of renal exploration. The signifi-cance of difference was estimated using chi square for qualitative variables, significantly attaining $p \leq 0.05$ on univariate analysis or multivariate analysis considered clinically relevant in final statistical analysis using SPSS® version 18.

Result

During study period included 107 patients of renal trauma, ninety-six (89.7%) were male and

eleven (10.3%) were female with overall mean age of 30.13 ± 13.6 (range 5-76) years were enrolled. 94 (87.9%) of included patients were blunt trauma mecha-nism whiles penetrating trauma founded 13 (12.1%) patients. The common cause of injury were road traffic accidents 64 (59.8%), falls 19 (17.8%), stab wounds 9 (8.4%), gunshot wounds 3 (2.8%) and others 12 (11.2%). Thirty-five of patients (32.7%) were isolated renal trauma and 72 (67.3%) of them presented with multi-organ injuries. Almost renal trauma patients presented with blood stream urine showing gross hematuria in 64 (59.9%) patients even though microscopic hematuria founded 39 (36.4%) cases. 80 of 107 patients (74.8%) diagnosed and graded depending on computed tomography (CT) prior admission, founded positive signs in 27 patients (33.8%) (peri-renal hematoma ≥ 3.5 cm.) and they need renal surgery in 7 patients (25.9%). Conversely, 53 patients (66.2%) whose renal negative signs on CT required renal exploration only 1 case (1.9%) according to infected urinoma. They were major renal trauma (grade IV or V) in 39 patients (36.4%), remaining (63.6%) were minor renal trauma (grade I-III). Epidemiological characteristics, clinical, laboratory and imaging finding of this study shown in Table 2.

Overall, 88 of 107 renal injured patients (82.2%) were successfully following with Non-Operatively treatment, In contrast, 19 patients (17.8%) necessary surgically renal exploration (Figure 1), According to 29 (27.1%) of the 107 patients, underwent immediate laparotomy due to unstable condition, however only 15 patients (57.2%) undergone renal surgery whiles 14 patients (48.3%) were abdominal operatively without kidney exploration. The high-grade renal trauma (grade IV, V), 24 of 39 patients (61.5%) conservative treat without any renal exploration, moreover, low grade kidney trauma (grade I-III), 64 of 68 patients (94.1%) success with the non-operative managed shown on Table 3. Those survived patients average stayed in hospital 13.3 days and transfused blood products in 55 (51.4%) patients whereas mortality case 10 of 107 patients (9.3%) were died without renal trauma related

NM: non-operative management, OM: operative management

There were no significant differences between conservative (non-operative management [NM] group; n = 88) and operative managed group (operative management [OM] group; n = 19) in terms of age, gender, mechanism, associated injury, hematuria and serum creatinine level. Meanwhile, the systolic blood pressure, heart rate, hemoglobin levels, findings signs on CT, renal severity, blood transfusion and immediate laparotomy were shown statistically significant differ-ences on Table 2.

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Table 2 Demographic, clinical, laboratory and radiologic characteristics of patients

		107 case (100%)		*P*-value
		NM 82.2% (88)	OM 17.8% (19)	
Age	< 50	73.8% (79)	15.9% (17)	1.00
	> 50	8.4% (9)	1.9% (2)	
Gender	- Male	74.8% (80)	14.9% (16)	0.408
	- Female	7.5% (8)	2.8% (3)	
Mechanism	**Blunt**			0.052
	- MVI	6.5% (7)	0.9% (1)	
	- MCA	35.5% (38)	6.5% (7)	
	- Pedestrian	8.5% (9)	1.9% (2)	
	- Falling	15.9% (17)	1.9% (2)	
	- Body assault	7.5% (8)	0%	
	- other	0.9% (1)	1.9% (2)	
	Penetrating			
	- Stab	5.6% (6)	2.8% (3)	
	- Gun	1.9% (2)	0.9% (1)	
	- other	0%	0.9% (1)	
Associated injury	**Multiple organ**	53.3% (57)	14% (15)	0.232
	Single organ	29% (31)	3.7% (4)	
SBP (mmHg)		118.14 (± 25.35)	89.95 (± 33.16)	0.003
HR (bpm)		94.44 (± 19.80)	103.26 (± 32.74)	0.001
Hematuria	- Gross	46.7% (50)	13.2% (14)	0.548
	- Microscopic	32.7% (35)	3.7% (4)	
	- None	2.8% (3)	0.9% (1)	
Hb level (mg/dl)	13.12 (± 2.29)	11.42 (± 2.62)		0.020
Serum Creatinine	1.08 (± 0.41)	1.44 (± 1.32)		0.142
CT finding	Perform	74.8% (80)		
	- Positive	25% (20)	8.7% (7)	0.002
	- Negative	65% (52)	1.3% (1)	
CT renal injury grading	1	30.8% (33)	0%	<0.001
	2	12.1% (13)	0%	
	3	16.8% (18)	3.8% (4)	
	4	16.8% (18)	3.8% (4)	
	5	5.6% (6)	10.3% (11)	
Blood transfusion	Yes	33.6% (36)	17.8% (19)	<0.001
	No	48.6% (52)	0%	
Laparotomy	Yes	13.1% (14)	14% (15)	< 0.001
	No	70% (74)	3.7% (4)	
Dead		9.3% (10)		
LOS mean (day)		13.3		

NM, non-operative management; OM, Operative management; MVI , Motor vehicle injury; MCA, motor cycle accident; SBP, systolic blood pressure; HR, Heart rate; LOS, Length of stay

Table 3 Frequency of Surgical Interventions According to Kidney Injury Severity

Severity of injury	Immediate Laparotomy (n = 29)				No Immediate Laparotomy (n = 78)	
	No Kidney Exploration	Kidney Exploration			No Kidney Exploration	Kidney Exploration
		Kidney Repair	Partial Nephrectomy	Nephrectomy		
Low grade	10	2	1	0	54	1
High grade	4	0	0	12	20	3

To define those factors independently associated with operative manage-ment on kidney injury using logistic regression analysis. Univariate analy-sis founded systolic blood pressure < 90 mmHg (OR 5.19, 95% CI 1.78-15.23; *P* = 0.003), heart rate rate > 100 beats/min (OR 5.96, 95% CI 1.82-19.45; *P* = 0.001), hemoglobin levels < 10 g/dl (OR 4.39, 95% CI 1.32-14.555; *P* = 0.02), findings positive signs on CT included medial parenchymal laceration, perirenal hematoma sized ≥ 3.5 cm. and intravascular extra-vasation (OR 18.2, 95% CI 2.10-157.47; *P* = 0.002), high-grade renal injury (OR 10, 95% CI 3.02-33.15; *P* < 0.001), blood transfusion (*P* <0.001) and immediate laparotomy (OR 19.82, 95% CI 5.72-68.64; *P* <0.001) were significantly correlated with needed operative treatment.

Table 4 Univariate and multivariate analysis of the factors that correlated with operative management (renal exploration).

Factors	Univariate Analysis				Multivariate Analysis			
	OR	95%CI		*p*-value	OR	95% CI		*p*-value
		Lower	Upper			Lower	Upper	
SBP < 90 mmHg	5.19	1.78	15.23	0.003	0.54	0.70	4.17	0.556
HR ≥ 100 bpm	5.96	1.82	19.45	0.001	1.80	0.32	10.31	0.507
Penetrating injury	3.57	1.02	12.51	0.052	2.82	0.34	20.01	0.299
Multiple injury	2.04	0.62	6.68	0.232	-	-	-	-
Hematuria	0.64	0.06	6.46	0.548	-	-	-	-
Hb < 10 mg/dl	4.39	1.32	14.55	0.020	1.04	0.17	6.18	0.969
Cr ≥ 1.2 mg/dl	2.11	0.77	5.80	0.142	-	-	-	-
Major renal trauma*	10.00	3.02	33.15	< 0.001	13.01	2.33	72.62	0,003
Positive CT finding	18.20	2.10	157.47	0.002	-	-	-	-
Need blood transfusion	-	-	-	< 0.001	-	-	-	-
Immediate laparotomy	19.82	5.72	68.64	< 0.001	8.96	1.49	53.8	0.016

OR, odd ratio; CI, confidence interval; SBP, systolic blood pressure; HR, Heart rate

However, Only high-grade renal injury is independently high odds needed kidney surgery on multivariate analysis (OR 13.01, 95% CI 2.33 – 72.62; *P* = 0.003) as shown in Table 4.

Discussion

This study showed most common mechanism of renal injury patients consequently from blunt trauma (80%) markedly from road traffic accidents over 60%, these finding similarly as other report that kidney is the most commonly injured of genitourinary organ, there could be founded up to 5% in trauma[7,8] and specifying increase to 10% in abdominal trauma,[1] with over all incidence about 4.9 per 100,000,[5] these preferences also highlight in young age and male gender.

Although currently literatures report-ed advantage of modern imaging studies in abdominal trauma, however, the computed tomography (CT) were still usefully as the modality of choice in hemodynamic-ally stable patients whether following blunt or penetrating trauma,[5] these investigations widely available and promptly accurated identify renal injury graded, also demonstrate the contralateral kidney together with associated organs injuries. According to renal trauma severity could be graded on finding whether laparo-tomy or imaging (CT), 80/107 (74.8%) whom investigated with CT to evaluate the severity following injured, only 8.7% of renal trauma whose necessary undergoing renal exploration shown positive finding signs on CT and associated with failure treatment conservatively, these correlative as multivariate analysis clarify positive signs on CT were not usually indicated surgery.

Several studies1 were grouping renal trauma into low and high-grade of injury which grade I-II as low grade and grade III-V as high-grade, whiles, some studies grouped grade I-III as low grade and grade IV-V as high-grade[3,4,9] to comparative outcome of management. This study classified renal injury as low grade (grade I-III) and high-grade (grade IV-V) based on Molyoopanao et al[10] previous study in our trauma center (Bhumibol Adulya-dej hospital) illustrative risk factor of high-grade renal trauma were gross hematuria and hypotension, however this study founded those factors were absent relatively to failure non-operative treatment.

The principle management of renal trauma were life saving and preserved parenchymal tissue to restorage function as much as possible. Now-adays, surgical intervention was decreasing on those treatment strategies surprisingly better organ preservation, therefore 90% of renal injuries can be managed conser-vative,[5] subsequently renal explor-ation rate in blunt trauma are less than 10%, whereas, exploration rate are currently high in penetrated injuries accordingly required debride-ment and bleeding controlled. This study revealed conservative manage-ment in renal trauma successes in 82.2% of patients, otherwise 29 patients need immediately exploration

according to associated abdomi-nal organ injury, however only 15 patients undergone renal exploration, therefore nephrectomy was done in 12 patients, partial nephrectomy once and kidney repaired in two cases. Furthermore, renal exploration was operated in only 4 patients whose initially conservative managed, three of them are high-grade. Eventually during initiating this study period, the intervention radiologist was un-available, at last thereafter they were feasible, renal preservative chance increasing finally 85% (91/107) of patients. Even high-grade paren-chymal renal injury was the strongest non-operation failure predictor, How-ever, this study emphasized hemody-namically stable patients should be achieved non-operative strategies under interventional radiologist collaboration.

Recently studies[1,3,4] reported motor vehicle accident, hypotension, associated organ injuries, high-grade renal injury, computed tomography (CT) imaging features (namely medial renal parenchymal laceration, peri-renal hematoma ≥ 3.5 cm and intravascular extravasation) and blood products transfusion were predictive needed surgery. This study demonstrates that hypotension, tachycardia, low hemoglobin levels, findings signs on CT, high-grade severity, blood transfusion, and the immediate laparotomy are associated with surgical intervention base on univariate analysis. Particularly, multivariable analysis clarify only high-grade renal injury (OR = 13.01 [95% CI, 2.33- 72.62]; p = 0.003) and immediate laparotomy (OR = 8.96 [95% CI, 1.49-53.80] ; p = 0.016) showed statistical significant. Even-tually the immediate laparotomy usually leaded nephrectomy due to patient unstable and limit time to clearly investigated renal severity. Naturally high-grade kidney injury seem to indicated surgery whether radiology intervention, however low number of trauma patients to demonstrated significantly in this study. The limitation of study including retrospective study, small sample size or no sample size enough to calculation in some analysis that need more time to corrected case and prospective review protocol should be initiation. The further study about the concerning complication such as urinoma, post-injury infections and non-functional kidney and long term follow up data in non-operative management of high-grade renal trauma was needed.

Conclusion

The low-grade renal trauma illustrated conservative treatment successfully. Alternately, high-grade parenchymal injury was the strongest non-operation failure predictor, however, the conservative approach strategies should be initiated in most blunt hemodynamically stable patients under collaborated with interventional radiologist enhanced acceptable in short term outcome and challenging.

References

1. Maarouf AM, Ahmed A-F, Shalaby E, et al. Factors predicting the outcome of non-operative management of high-grade blunt renal trauma: Afr J Urol. 2015;21(1):44-51.
2. Mattox KL, Moore EE, Feliciano DV, et al. Trauma 7th edition: McGraw- Hill Medical; 2013:1224.
3. Lanchon C, Fiard G, Arnoux V, et al. High-grade Blunt Renal Trauma: Predictors of Surgery and Long-Term Outcomes of Conservative Management. A Prospective Single Center Study: J Urol. 2016;195(1):106-11.
4. Moudouni SM, Patard JJ, Manunta A, et al. A conservative approach to major blunt renal lacerations with urinary extravasation and devitalized renal segments: BJU Int. 2001;87(4):290-4.
5. Summerton D J, Djakovic N, Kitrey N D, et al. Guidelines on Urological Trauma, 2015. Available at: http://-uroweb.org/guideline/urological-trauma/.
6. Cobum M. Urology Surgery. In: Sabiston D C, Townsend C M, Evers B M,editors. Sabiston textbook of surgery, the biological basis of modern surgical practice. 19thed; Philadelphia: Elsevier Saunders. 2012;2059-2068.
7. Morey AF, Brandes S, Dugi DD, et al. Urotrauma: AUA Guideline. J Urol. 2014;192(2):327-35.
8. Serafetinides E, Kitrey N D, Djakovic N, et al. Review of the Current Management of Upper Urinary Tract Injuries by the EAU Trauma Guidelines Panel. Eur Urol. 2015;67 (5):930-6.
9. Starnes M. Complications Following Renal Trauma. Arch Surg. 2010;145(4):377.
10. Booranapitaksnati D. Predictive Factors for Severity of Renal Trauma. Bhumibol Adulyadej Hospital, 2011.