Management of liver trauma in urban university hospitals in India: an observational multicentre cohort study

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Abstract

Background

Low- and Middle-Income Countries (LMICs) contribute to 90% of injuries occurring in the world. Liver is the one of the commonest organ injured in abdominal trauma. This study aims to highlight the demographic and management profile of liver injury patients, presenting to four urban Indian university hospitals in India.

Methods

This is a retrospective registry-based study. Data of patients with liver injury either isolated or concomitant with other injuries was used using the ICD-10 code, S36.1 for liver injury. The severity of injury was graded based on the World Society of Emergency Surgery (WSES) grading for liver injuries.

Results

A total of 368 liver injury patients were analysed. 89% were males, with road traffic injuries being the commonest mechanism. As per World Society of Emergency Surgery (WSES) liver injury grade, there were 126 (33.7%) grade I, 87(23.6%) grade II, 67(18.2%) grade III & 88 (24.5%) grade IV injuries. The overall mortality was 16.6%. 262 patients (71.2%) were managed non-operatively (NOM) & 106 (38.8%) were operated. 90.1% of those managed non-operatively, survived.

Conclusion

In this multi-centre cohort of liver injury patients from urban university hospitals in India, the commonest profile of patient with a was a young male, with a blunt injury to the abdomen due to a road traffic accident. Success rate of non-operative management of liver injury is comparable to other countries.

Introduction

Injuries account for 4.8 million lives globally and deaths due to road traffic injuries alone are amongst the top 10 causes of mortality [1][2]. Seven to ten percent of all injuries occur involve the abdominal region, making it third most common region injured following traumatic brain injury (TBI) and extremity injury [3, 4]. Liver and spleen injuries are the commonest damages in blunt abdominal trauma [5].

Promising outcomes of non-operative management (NOM) in paediatric splenic injuries, has shifted the definitive treatment of these injuries from operative management (OM) to NOM[6][7]. Higher grade injuries to the liver can be conserved if the patient is hemodynamically stable[8, 9]. NOM is based on the understanding that an injury which appears severe may not necessarily exsanguinate and haemostasis

does occur naturally, at least in some cases. NOM is now possible because of multidetector computerized tomography (CT) scan, intervention radiology and intensive care monitoring along with a paradigm shift in the concept of haemostasis[10]. This has decreased the mortality and morbidity in patients with high grade liver trauma. OM of liver injury is only considered for those who are hemodynamically unstable or if NOM fails[8].

LMICs like India contribute to 90% of all the global injury burden, which is a critical public health issue[11]. Most published literature from India are anecdotal or single centre studies with small database[12–17]. A multi-centre hospital-based registry can help in better understanding the outcomes in the management of organ-specific injuries. In 2013, a four university hospital registry study, called Towards Improved Trauma Care Outcomes in India (TITCO), was initiated to observe the demography, injury etiology, management and outcomes of injured patients in urban India. [18]. The aim of this study is to conduct a sub group analysis of patients with liver injuries, managed in one such a large multi-centre hospital-based registry in urban India.

Methods

Study design

This is a retrospective registry-based study with data extracted from a prospective cohort study called Towards Improved Trauma Care Outcomes in India (TITCO). TITCO study is a multi-centre research consortium of university hospital formed to develop a trauma registry in India.

Setting

The study was conducted in four public university hospitals in India between October 2013 and December 2015. The hospitals included in the study are from three metropolitan cities, namely Mumbai, Delhi and Kolkata. The hospitals were King Edward Memorial Hospital (KEMH) and Lokmanya Tilak Municipal General Hospital (LTMGH) in Mumbai, Jai Prakash Narayan Apex Trauma Centre (JPNATC) in New Delhi and the Institute of Post-Graduate Medical Education and Research and Seth Sukhlal Karnani Memorial Hospital (SSKM) in Kolkata.

The urban referral trauma centres are situated in Kolkata, Mumbai (2-centers) and Delhi, cities with populations of more than 10 million. Except for the JPNATC, which is a standalone trauma centre, the others are trauma units providing trauma care as a part of a general hospital. The user fees are nominal and classified as free-to-public. The hospitals mainly serve the lower socioeconomic strata of the population in their respective area. Each of these hospitals receive 40 to 100 major trauma patients per week. They have round the clock emergency services, imaging, operating theatres and sub-speciality available.

Source and method of participant selection

All admitted patients that presented with history of trauma on arrival to any of the study hospitals were included in the TITCO registry. Data of patients with liver trauma either isolated or concomitant with other injuries was extracted using the ICD-10 code, S36.1 for liver injury.

Data Collection

Project officers included those with a master in science, who were then trained in the methods of data selection for the study in a workshop format, for a period of one week. These trained project officers at each hospital, worked eight-hour shifts with a rotating schedule between day, evening and night shifts through all days of the week. Data from patients admitted outside of the shift hours was collected retrospectively from the hospital medical records. The patients were followed up until discharge, death or to a maximum of 30-days. If discharged before 30 days, the patients were considered to be alive at 30 days. There was no follow-up after patient discharge or after the 30 days.

Study Variables

The primary outcome was 30-day in-hospital mortality following liver injury. Patients who died during their hospital stay up to 30 days was recorded. Those discharged before 30 days were considered to be alive at 30 days. The data set was analysed for patients' demographic profile, mechanism of injury, severity, management and outcome.

The data also included serially recorded parameters like pulse, systolic blood pressure (SBP), Glasgow Coma Score (GCS) and interventions done, if any. Those patients with a systolic blood pressure of $\leq$90 mmHg were considered as hemodynamically unstable having hypotension.

The severity of injury has been graded based on the World Society of Emergency Surgery (WSES) guidelines. WSES grading of liver injuries has graded based on the American Association of Surgery for Trauma (AAST) scale (anatomical classification of liver injuries) and the hemodynamic stability (physiological parameter) for grading liver injuries from I-IV [8]. The classification has been added as additional file. (see additional file A-1).

Patients management was divided and labelled as operative management (OM) in those who underwent laparotomy and NOM in those who were conservatively managed without a laparotomy. Those patients who survived NOM were labelled as successfully managed. The patients who died after NOM were labelled as NOM failure. The overall management of these patients along with the treatment for other associated injuries was recorded.

Quantitative variables

All continuous variables were represented as mean with their standard deviation and categorical variables as counts and proportions. ISS was represented as median with inter-quantile range.

Results

Demographics and Liver trauma Profile (Table 1**)**

Table 1
Demographics & Clinical Profile of patients with Liver Injury

Variables	Value n = 368	Missing Values (n)
Age	26 (12.7)	0
Male; n (%)	328 (89%)	0
Mechanism of Injury	210 (57.07%)	2
1.Road Traffic Accident	24 (6.52%)	
2. Railways	39 (10.6%)	
3. Assault	79 (21.47%)	
4. Falls	14 (3.8%)	
5. Other		
Blunt injury	337(91.6%)	0
Heart Rate (beats per minute)	99 (19.3)	8
Systolic BP (mm of Hg)	108 (23.4)	9
Haemoglobin gm/dl (Mean ± SD)	11 (2.1)	21
ISS score Median (IQR)	17 (10–22)	
GCS Score	13.4 (3.3)	11
Length of Stay, in days Median (IQR	8.5 (4.8–15.0)	2
Units of blood received in those operated (mean)	153 units (1.4)	-
WSES Liver Injury Grade	126 (33.7%)	
I	87 (23.6%)	
II	67 (18.2%)	
III	88 (24.5%)	
IV		
Continuous variables are represented by mean with their standard deviation in parentheses except ISS where it is shown as median and IQR. Categorical variables are represented as counts and proportions in parenthesis		

Out of the 16047 trauma patients in the TITCO registry, 1134 (7.1%) patients suffered abdominal trauma, of which 368 (32.5%) had liver trauma. Age range varied between 2 to80 years with the mean age of 26 years with 328 (89%) being males. The main mechanism of injury was road traffic injury (RTI) accounting for 57% of the patients. Among the RTI, the largest group were motorcyclist injuries (30.48%). More than half the patients were transferred patients from other referral centres (58.2%). 91.5% of the cohort with liver injuries had blunt injuries. 88 (24.5%) patients presented on arrival with SBP of ≤ 90 mmHg.

Most of liver trauma patients belonged to grades I-III grades (75%). The most common intra-abdominal injuries associated with liver trauma were spleen (17%) and kidney (14%) (Fig. 1). 85 patients had an associated TBI of which 38 (44.7%) had moderate to severe TBI based on GCS.

Management & Outcome in liver injury (Fig. 2**)**

Diagnostic modalities

Focused Assessment Sonography for Trauma (FAST) was done in 345 patients (93.8%) and a CT scan was done in 310 (84.24%) patients included in the study.

Overall mortality

Overall, 30 day in-hospital mortality rate in this cohort of liver injury with/without other injuries was 16.6% (61 out of 368).

Non-operative management

Out of 368 patients with liver trauma and other associated injuries, 262 (71.2%) patients had (NOM). Among these, 236 patients (90.1%) were successfully managed (survived) (Fig. 3). As per the WSES grades of injury the NOM success rates were, grade 1- 90.2%, grade 2–90.6%, grade 3–93.1% and grade 4–81.6%. Death occurred in 26 patients (9.9%). 4 of them died within 24 hrs of arrival, 11 died between 24 hrs to seven days after arrival and 11 died after 7 days from arrival (time data of one patient was missing). Of those who died, 7 patients had severe TBI (< 8 GCS and intracranial injuries), 5 patients had mild TBI (> 12 GCS), 2 patients had hypotension and TBI, 5 patients had hypotension without TBI and seven of those who died had no hypotension on arrival and no TBI.

Operative management

106 patients underwent emergency laparotomy which included various procedures such as packing both perihepatic and intraparenchymal haemostatic packs, direct suture ligation of lacerations, anatomic or nonanatomic segmental hepatectomy for liver injury, splenectomy, nephrectomy and bowel suturing for associated injuries. 12 (20.8%) patients with penetrating injury underwent OM compared to 9 (3.5%) patients with blunt injury. Of these 12 penetrating injuries 3 patients died. Among the operated 106 patients, 13 patients (12%) were taken to operating room within 1 hour of admission while the rest

underwent surgery within 24 hours of admission. 46 (43.4%) patients did not get a CT scan done before surgery. SBP just before surgery was ≤ 90 mmHg in 23 patients and > 90 mmHg in 82 patients. In one patient SBP was not recordable.

As per the WSES grades of injury, of who underwent OM; 26 (20.3%) were Grade 1, 32 (33.3%) were Grade 2, 11 (15.9%) Grade 3 and 37 (49.3%) Grade 4. The operative management cohort differed from the non-operative cohort significantly in their mean SBP 99(26.2%) vs. 111(21.0%), proportion of penetrating injury 21.7% vs. 4.4%, heart rate 103 (2.4) vs. 97 (18.5)] & ISS 14(9–22) vs. 17(12–22)]. Univariate analysis showed no difference between these two cohorts in their age and GCS (Table 2). The injury severity score (ISS) in the NOM group was higher, compared to those who underwent laparotomy. One-third of the patients who underwent laparotomy died (35 out of 106). The causes of death in these patients cannot purely be assigned to liver trauma as they had multiple injuries. 14 of them died within 24 hours of arrival, 16 died between 24 hours to 7 days after arrival and 8 died after 7 days (Time data of one patient was missing).

Table 2
Comparison of patient's physiological variables who underwent laparotomy versus those who underwent non operative management.

Variables	OM n = 105	NOM n = 263	p-value
Age	28 (12.8)	25 (12.6)	p = 0.07 ttest
Penetrating injury (%)	9 (3.5)	22 (20.8)	p < 0.05 ttest
SBP (mmHg), Mean (SD)	99 (26.6)	111(21.0)	p < 0.05 ttest
Heart Rate (Beats per minute), Mean (SD)	103(20.4)	97 (18.5)	P < 0.05 ttest
GCS, Mean (SD)	13 (3.9)	14(3.1)	p = 0.14 ttest
ISS, Median (IQR)	14 (9–22)	17 (12–22)	P < 0.05 (Wilcoxon Rank sum test)
Mortality, n (%)	35(33.0%)	26 (9.9%)	p < 0.05 chi sqaure
SBP Systolic Blood Pressure, GCS – Glasgow Coma Scale, OM- Operative Management (Laparotomy), NOM- Non Operative Management, ISS- Injury Severity Score.			

Discussion

To our knowledge this the first analysis of an Indian multi-centre cohort of liver injury patient's and has one of the largest cohorts analysed in India and probably across LMICs.

In our study, a third of all the abdominal trauma patients had liver injury. More than half were RTI and the majority were blunt type of injury to the abdomen. In our study the proportion of liver injuries within

abdominal region was 33% and is similar to other studies from India which reported 23-35% of all the abdominal injuries[19–21]. However, this is lower than the proportion of 42-52% reported from studies from Africa and Italy [4, 22]. In India, blunt abdominal trauma due to RTI is the commonest mechanism of injury except in the state of Jammu and Kashmir (a conflict zone) which has a higher proportion of penetrating abdominal trauma[20]. In countries where assault is common, penetrating injuries is the most common cause of abdominal injury thence liver injuries [23–25].

The mean age was 26 years with a predominance of males (89%). This could be as Liver injury occurs most commonly in young adults who extensively travel for work and engage in sporting activities compared to women. [26]. In our cohort also reflects this, with RTIs being more common in males, compared to females who predominantly have falls. Consequently, liver injuries are common in males.

In our cohort of liver injury patients, 90-93% of the WSES grade 1-3 liver injuries were successfully managed using non-operative management (NOM) strategy. In WSES grade 4 liver injuries, this number of NOM success reduced to 84%. Progress in the management of liver trauma towards the end of the 20th century has reduced the mortality[7]. Serial imaging, advancements in critical care and adjunctive therapies like angiography, percutaneous drainage, endoscopy/endoscopic retrograde cholangiopancreatography management of hepatic injuries have resulted in improved outcomes [9]. Literature suggest most liver injuries of grade 1-3 are treated by NOM with 82-100% success [9, 27, 28]. However, studies comparing OM versus NOM in high grade liver injury are still evolving [29]. Our comparisons of the two cohorts showed poor outcomes in those undergoing OM. On admission, the OM cohort had poor physiological variables compared to NOM, suggesting this cohort to have more serious injuries. Median ISS of OM cohort (ISS=14) was significantly less compared to that with the median ISS of NOM cohort (ISS=17). ISS is a poor predictor of severity in LMICs. This has been repeatedly demonstrated in predictor studies on mortality in trauma[30, 31].

Limitations

Data regarding the patients requiring adjunctive procedure for management of liver injury were not recorded in this study. We don't have data regarding the cause of mortality in patients who were initially managed non-operatively. Morbidity of NOM was not recorded. The results of this study are generalizable to the urban university hospitals in India and perhaps the other similar university hospitals in LMICs.

Conclusion

In this multi-centre cohort of trauma patients from urban university hospitals in India one third of those with a blunt trauma to the abdomen suffered a liver injury. Operative management was undertaken in less than one third of those with liver injury. Success rate of non-operative management of liver injury is comparable to other countries.

List Of Abbreviation

Low and Middle Income Country (LMIC), World Society Emergency Surgery (WSES), Non-Operative Management (NOM), Operative Management (OM), Towards Improved Trauma Care Outcomes (TITCO), American Association of Surgery for Trauma (AAST), Road Traffic Accidents (RTA), Traumatic Brain Injury (TBI), Systolic Blood Pressure (SBP), Injury Severity Score (ISS), Glasgow Coma Scale (GCS), Focussed Assessment with Sonography in Trauma (FAST).

Declarations

Ethics approval and consent to participate

The TITCO project was granted waivers of informed consent from all study centres. The study received approval from the institutional ethics committee of the four centres involved in the study. The ethics approval registration numbers were EC/NP-279/2013 RP-O1/2013 from the All India Institute of Medical Sciences Ethics Committee, IEC/11/13 from the Lokmanya Tilak Municipal Medical College and Lokmanya Tilak Municipal General Hospital Institutional Ethics Committee, IEC/279 from the Institute of Post Graduate Medical Education and Research (IPGME&R) Research Oversight Committee (Institutional Ethics Committee), and IEC(I)OUT/222/14 from the Seth GS Medical College and King Edward Memorial Hospital Institutional Ethics Committee.

Consent for publication

Not applicable

Availability of data and materials

The data are available to whoever wants by emailing the corresponding author or the last author (MGW). They can write their aim or objective, and then the authors can decide if that study can be done without duplication of work.

Competing interests

None declared

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Authors' contributions

Authors YS, MUK, RPP have conceptualised, designed, analysed and interpreted the data. NR & KS has contributed to the design and analysis of the manuscript. SM, SD contributed to the analysis and interpretation of data. MGW contributed to the design, concept and interpretation of data. All authors contributed to drafting the article and revising it, and approved the final version. All authors agree to be responsible for all aspects of the work.

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Figures

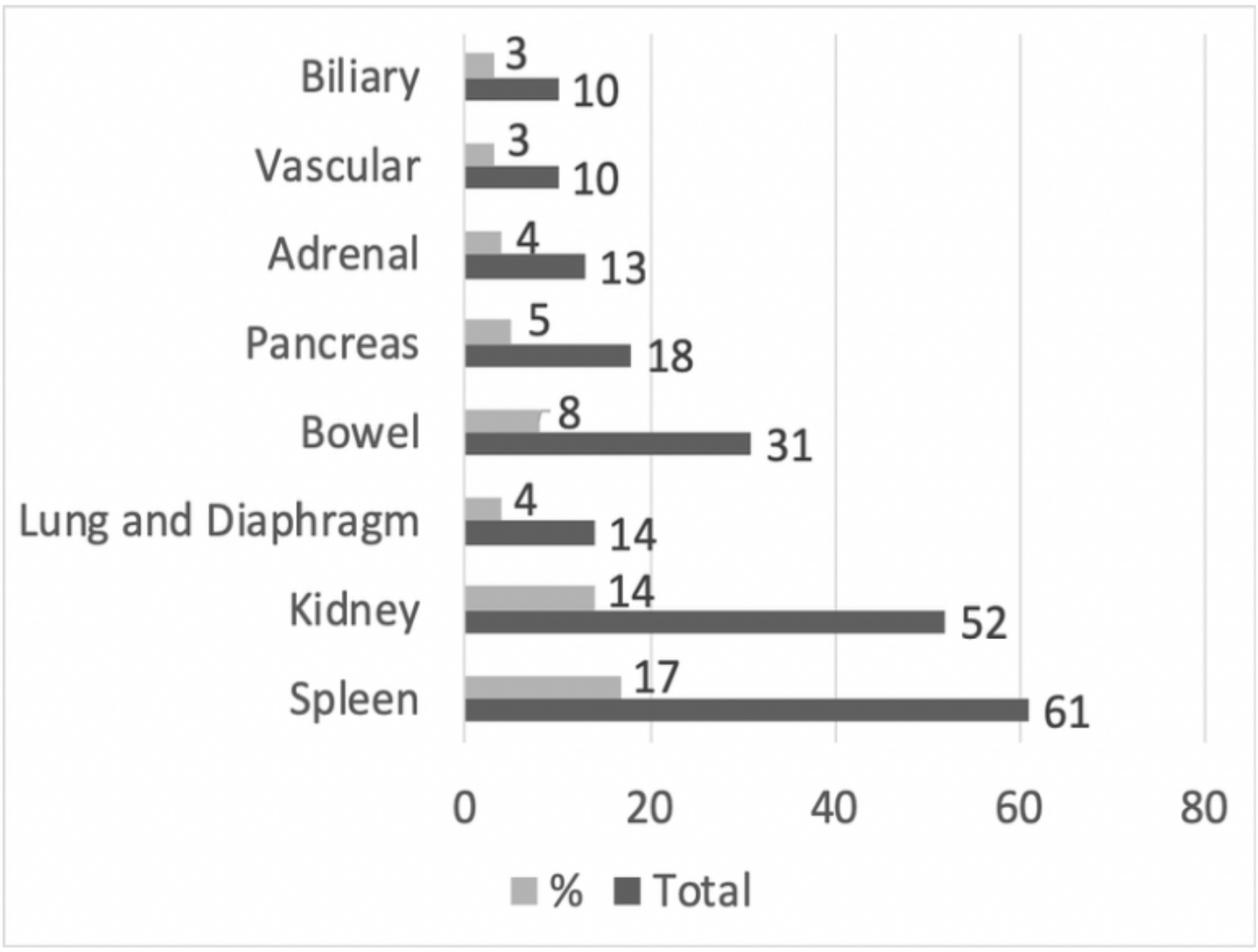

Figure 1

Number and Proportions of liver injury patients who have other organ injuries

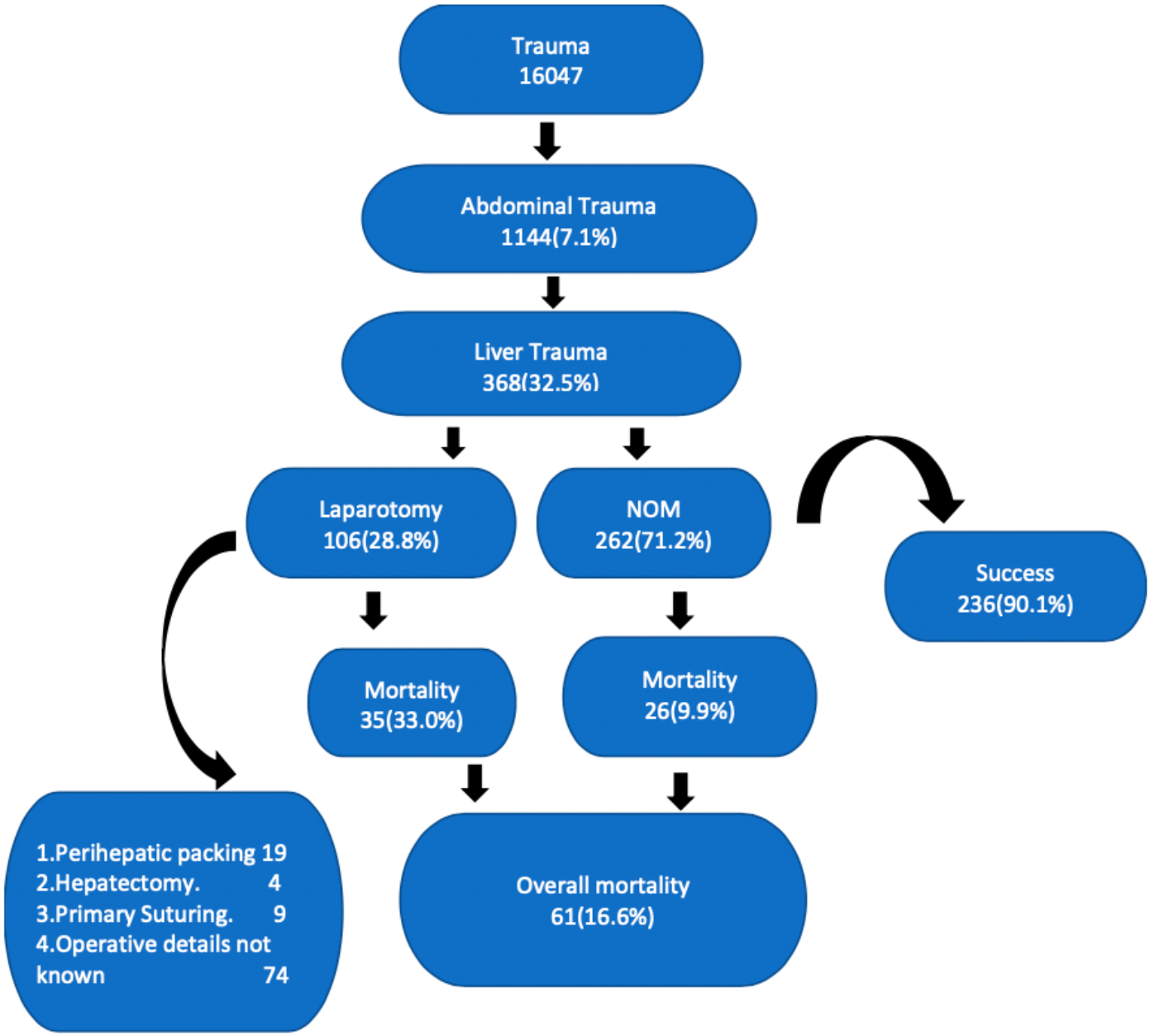

Figure 2

Management and outcomes in Liver injury patients

Supplementary Files

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