ORIGINAL ARTICLE

A Preliminary Study of Possible Prognostic Factors of Traumatic Liver Injury seen at University Hospital, 1984-1991

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Summary

A retrospective study was carried out on 42 patients (38 males, 4 females, mean age 25.9) with liver injury at the University Hospital, Kuala Lumpur from 1984 through to 1991. Prognostic factors that might help to identify those patients with an increased risk of dying from the injury were analysed. In this preliminary investigation, patient survival was related to pulse rate on arrival (< or = 120 beats per minute, p=0.027), systolic blood pressure at induction of anaesthesia (> or = to 80 mmHg, p=0.003) and intraoperative blood transfusion of < or = to 4 units (p=0.05). These data were supported by the 95% confidence interval suggesting that these factors may be strong prognostic indicators individually. Increased mortality was also associated with increased total blood transfused (p=0.002) and grade of liver injury (p=0.02). Although the factors we have identified reflect both the severity of injury and resuscitative and surgical efforts, further studies using a prospective design are required to confirm these findings.

Key Words: Liver trauma, Prognostic factors

Introduction

Malaysia, like the rest of the world, is seeing an increased incidence of motor vehicle accidents and violence[1,2]. These result in the death of young and productive members of our society. Among the main cause of death in these patients is intra-abdominal injuries especially those involving the liver[3,4].

Although the mortality from liver trauma has decreased from 60% during World War I[5] to 27% in World War II[6] due to progress in resuscitation, anaesthesia and intensive care, it is still considerable; current mortality rates of 10% to 20% are often quoted[7,8]. The principle cause of death in hepatic injury is bleeding[9].

Because of its increasing frequency and high mortality, the authors set out to identify prognostic factors that might help to identify liver trauma patients with a high mortality risk. This may help to provide guidelines for the future management of these patients. However, individual hospital policies in the management of liver trauma must be taken into account when doing so.

Materials and Methods

Over an 8-year period (96 months), from January 1984 through December 1991, 65 patients underwent laparotomy for liver injury at the University Hospital, Kuala Lumpur. We performed a retrospective analysis on 42 of these patients in whom complete medical records were available.

Data obtained included patient biography, mechanisms of injury, time of transfer from injury to the accident and emergency unit, method of diagnosis, blood pressure and pulse rate on arrival at hospital, time from initial hospitalisation to operation, blood pressure at induction of general anaesthesia, operative findings, transfusion requirement, mortality and period of hospitalisation.

These parameters were analysed individually with regards to prognosis. Statistical analyses were performed using Chi-square test, and Fisher's exact test when the expressed value is less than 5. Chi-square test for trend was used to assess for the existence of linear trend. All the tests were performed using significance level of 0.05. The magnitude of association using odds ratio and 95% confidence units were also calculated.

Results

Patient biography

Of the 42 cases, there were 38 males and 4 females (9.5:1). Age ranged from two to 56 years, with a mean of 25.8 +/-12.3 years for males and 26.8 +/-20.1 for females (Fig. 1).

Mechanisms of injury

Most of injuries were due to motor vehicle accidents (88.1%), while other causes included gunshot wounds (4.8%), fall from heights (4.8%) and stab wounds (2.3%).

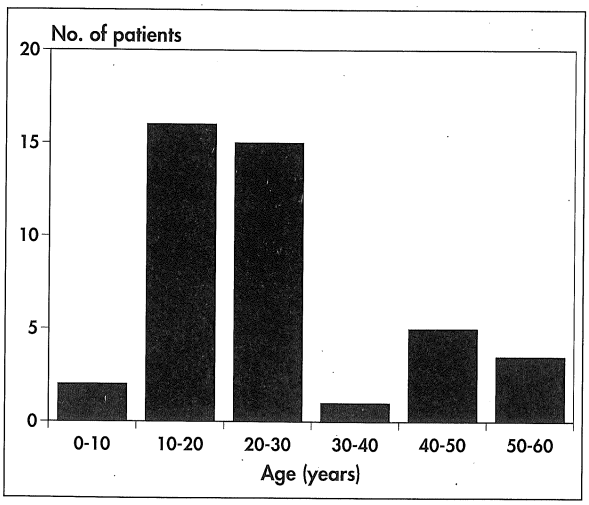

Fig. 1: Liver trauma patients – age distribution

Transfer time from site of injury to the Accident and Emergency Department

It was only possible to determine the time interval from injury to arrival at hospital in 22 patients. Twenty patients could not recall the exact time of injury because of cerebral concussion or head injury. We could not demonstrate any significant difference in mortality between patients arriving at hospital after different periods from the time of accident (Table I).

Method of diagnosis

Preoperative diagnosis of liver or visceral injury was based on the findings of peritonism in 13 (31%), peritoneal tap in 21 (50%) and peritoneal lavage in 8 (19%) of the patients.

Vital signs on arrival at the Accident and Emergency Department

Systolic blood pressure on arrival ranged from 0 to 167 mmHg (mean 101 +/- 39 mmHg). Of the 3 patients whose blood pressure were unrecordable on arrival at hospital, one had right atrial tear, another with a shattered right lobe of liver and the third, a tear in the inferior vena cava. All three patients died. The latter, also had unrecordable blood pressure at induction of anaesthesia and died intraoperatively while the other two patients died 27 days after hospitalisation. Systolic blood pressure upon hospitalisation was found not to affect the prognosis in our study.

Pulse rate on arrival at the hospital ranged from 0 to 150 per minute (mean 93 +/- 33 per minute). Seven of the 10 patients whose pulse rate on arrival was greater than 120 per minute died (70%), compared to nine of 32 patients with pulse rate of 120 or less per minute (28%) (p=0.027).

Duration from hospitalisation to operation

The shortest duration from hospitalisation to operating theatre was 20 minutes. The longest duration was 2 days because of diagnostic difficulties in a patient with stable haemodynamics. This latter patient survived. This lag time from hospitalisation to operating theatre

Table I
The distribution of cases of traumatic liver injury with respect to possible prognostic factors and outcome

Factors	Outcome		p value	O.R. (95%C.I)
	Survived	Died		
Transfer time[1] (in mins)				
<= 40	9	3	0.192	4.5 (0.5-43.8)
> 40	4	6		
Total	13	9		
Pulse rate (arrival) (beats min-1)				
<= 120	23	9	0.027	6.0 (1.0 - 41.8)
> 120	3	7		
Total	26	16		
BP (arrival) (mmHg)				
<= 80	6	5	0.720	0.7 (0.1 - 3.4)
> 80	20	11		
Total	26	16		
Time to OT[2] (hours)				
<= 2	12	9	0.751	0.7 (0.2 - 3.0)
> 2	13	7		
Total	26	16		
BP (induction) (mmHg)				
<= 80	1	7	0.003	0.1 (0.0 - 0.5)
> 80	25	9		
Total	26	16		
Intraop Transfusion (units)				
<= 4	14	3	0.05	5.1 (1.0 - 33.0)
> 4	12	13		
Total	26	16		
Postop Transfusion (units)				
<= 2	17	3	0.09	4.0 (0.8 - 26.2)
> 2	13	9		
Total	30	12		

Footnote: [1]Twenty cases and [2]one case not documented.

however does not significantly affect survival, as almost all patients were operated on as soon as possible.

Blood pressure on induction of anaesthesia

On induction of anaesthesia the patients have systolic blood pressure ranging from 0 to 160 mmHg. Four patients have zero blood pressure on induction. These patients have major bleeding from vena cava[3] and shattered right lobe of liver[1] and failed to respond to earlier resuscitative measures. Only the latter arrived at hospital with unrecordable systolic blood pressure. Seven of the eight patients with systolic blood pressure of 80 mmHg or less on induction died (88%) compared to nine of the 34 whose systolic blood pressure was greater than 80mmHg (27%) (p=0.003).

Transfusion requirement

The 42 patients were given a total of 589 units of blood, ranging from 0 to 57 units. Increased total blood transfusion was associated with higher mortality (Table II).

The blood transfusion was further analysed according to pre, intra and post operative requirement. Eighteen of the 42 patients had preoperative transfusion, ranging from 1 to 5 units. Analysis showed no correlation between pre and postoperative transfusion and the likelihood of death. However, for the 25 patients who received intraoperative transfusion of more than 4 units there were 13 deaths (51%) compared to 3 deaths among 17 patients who received 4 units or less (8%) (p=0.05).

Pattern of injuries

During operation, most liver injuries were found to involve the right lobe (76.2%), compared to left lobe (11.9%) or bilobar involvement (11.9%).

The liver injuries were stratified according to the method described by Little *et al*[7]. Patients were found to be in Grade IV to VII. Mortality rate rose with the severity of injury (Table III).

Twenty-four patients underwent hepatic suturing, 12 perihepatic packing, 10 formal hepatic resection, 1 debridement and in 7 no procedure was performed. Most patients had other concommitant injuries. (Table IV).

Mortality

Overall mortality was 38% (16 deaths). Seven deaths were attributed wholly or in part to liver trauma while 9 others resulted from other organ failure.

Period of hospitalisation

Of the survivors, 50 per cent required hospitalisation of more than 20 days.

Table II
Blood transfusion and mortality

Units of blood	Outcome		Mortality (%)	Odds ratio
	Survived	Died		
0 - 10	19	4	17.4	1.0
10 - 20	4	4	50.0	4.8[1]
> 30	3	8	72.7	12.7
Total	26	16	38.0	

Chi-squared test for linear trend=9.95 with 1 d.f.; p=0.002
Footnote: [1]relative to baseline

Table III
Liver injury grade and mortality

Injury grade	Outcome		Mortality(%)	Odds ratio
	Survived	Died		
Grade IV	13	3	18.8	1.00
Grade V	5	3	37.5	2.60[1]
Grade VI	6	5	45.5	3.61
Grade VII	2	5	71.4	10.8
Total	26	16	38.0	

Chi-square test for linear trend=5.73 with 1 d.f.; p=0.02
Footnote: [1]relative to baseline

Table IV
Concomittant injuries

Site	Patients
1. Head	
Major	6
Concussion	16
2. Chest	15
3. Fractures	
Upper limbs	7
Lower limbs	13
Pelvis	4
Spine	2
4. Bladder	1
5. Abdomen	
Pancreas	1
Adrenal	2
Heart	2
Kidney	5
Spleen	9
Stomach	1
Small bowel	3
Large bowel	3

Discussion

The management of liver injury is fraught with many hazards. Few situations challenge a surgeon so thoroughly as a severe liver injury. Haemorrhage is still the most common cause of death.

Preoperative management of these patients is directed towards establishing the presence of liver injury, the care of shock and preparation of patients for surgery if needed. Since bleeding is the major cause of death in liver trauma, early resuscitation would result in a better outcome. By prompt and adequate volume replacement, we should be able to improve survival. In countries like Australia where paramedical services are available it was found that 20% of patients benefited from early resuscitation at the roadside and about 10% reached the hospital alive because of this service[10]. However, there is a fine balance between duration of resuscitation and time for surgical intervention. The period of resuscitation varies with the severity of injury, the presence or absence of associated injuries, severity of shock and the response to resuscitation as indicated by decreased pulse rate and improved blood pressure. Failure of respond to adequate resuscitation is an absolute indication for immediate surgical intervention[5]. To administer blood and postpone operation beyond this point would be of futile in a patient with continuous intra-abdominal bleeding. A major cause of continuous bleeding is juxta hepatic venous injuries and this is known to carry a mortality of 50% to 90%[11,12]. If the patients survived surgery after a massive transfusion, complications such as coagulopathy and multisystem failure will also lead to a poor prognosis. Croce and co-workers have found

that transfusional requirement correlated relatively well with the operative injury grade (AAST Organ Injury Scale)[13]. Historically, a better outcome was achieved when World War II victims with liver injury were resuscitated to a systolic blood pressure of 80 mmHg prior to transfer to hospital for definitive surgery[5].

Because blood loss is a major cause of death in liver trauma and resuscitation is an important determinant in its outcome, haemodynamic parameters such as pulse rate, blood pressure, time taken for resuscitation to be initiated (transfer time to accident and emergency department), time to surgical intervention and total blood transfused, which can be easily measured and documented even in peripheral hospitals will be very helpful if they can be used to prognosticate the outcome in traumatic liver injury.

Our study demonstrated that there was increased mortality associated with the total amount of blood transfused. This is not surprising as it indicates existing or continuing blood loss. Mortality also rose with the grade of liver injury as demonstrated by other workers[7]. Patients who were not tachycardic above 120 per minute on arrival to the accident and emergency department, who responded to resuscitation and achieved systolic blood pressure of at least 80 mmHg on induction of anaesthesia and those receiving less than four units of blood intraoperatively have a better survival. However this finding was not reflected in the 95% confidence interval which leads to the suggestion that the above factors are not altogether the definitive prognostic indicators for liver trauma.

In view of this, we need to be cautious in relying absolutely on these parameters as prognostic factors in liver injury. However, there remains a definite role for the identification of prognostic factors that may help us predict outcome among these patients.

Other studies have shown an association of increased mortality with an increase in the number of associated injuries[12]. Little *et al* have also worked out other determinants of death due to liver trauma in an Australia setting where the services of paramedics are available. They found that factors that were associated with higher mortality were the severity of injury, unconsciousness, blunt trauma, presence of coagulopathy and shock[7].

Further in-depth investigation by the way of prospective and if possible, multicentre studies, with a larger sample size should be performed to verify our findings. These prognostic factors and others as mentioned may eventually have a broader spectrum of application in predicting outcomes not only in liver but also in other injuries where the major cause of death is haemorrhage.

Conclusion

We have identified possible prognostic factors that may influence the management and outcome of patients with liver injury. When factors studied were considered individually, the following were shown to affect patient survival: pulse rate on arrival to hospital, systolic blood pressure at induction of anaesthesia, the amount of blood transfused intraoperatively, total amount of blood transfused and the grade of injury. Further studies will be needed to confirm our findings. Identification of these prognostic factors should lead to improvement in the prognosis of patients with major liver injury.

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