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## Prognosis of abdominal injuries in trauma patients in two university hospital unit of Lubumbashi

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### Abstract

**Introduction:** Abdominal trauma is a major public health concern. The purpose of our study was to determine the frequency, the etiologies and to assess the management as well as the evolution of abdominal trauma in Lubumbashi.

**Patients and Methods:** This was a cross-sectional descriptive study carried out in surgical emergency department of two university hospital units, the University Clinics of Lubumbashi and the Janson SENDWE Provincial Referral Hospital over a period from January 2018 to December 2021. We reviewed prospectively medical records of patients who had laparotomy or not after abdominal trauma. It had involved 93 patients with abdominal trauma. Statistical analyzes were performed using Epi info 7.2.2.6 software and IBM SPSS 25 software.

**Results:** We collected 93 files. The frequency of severe abdominal trauma managed in our department was 3.89%. Etiologies were dominated by road traffic accidents (62.37%). There was a male predominance (83.87%) and the average age was  $28.77 \pm 13.84$  with extreme ages 1 and 68 years old. The median admission time was 2 hours; many patients arrived at the hospital within an hour (41.94%) and 52.68% of patients were hemodynamically unstable. Fifty two point seventy five percent of surgeries lasted between one to two hours. Abdominal contusions have represented 66.37% of cases and abdominal wounds 34.63% of cases. Indications for surgery were hemodynamic instability, evidence of lesion of a hollow viscus, the presence of evisceration or a gunshot wound, and initial non-operative treatment failure. The organ most affected in abdominal trauma remains the spleen in thirty-two patients (34.40% of cases), followed by the liver in twenty-four patients (25.80% of cases). Forty four point eight percent of patients had a hospital stay between 8 and 14 days with an average hospital stay of  $10.87 \pm 6.27$  days. Postoperative morbidity was 34.41% dominated by intra-abdominal re-bleeding in 9.67% and overall mortality was 23.66%.

**Conclusion:** Abdominal trauma remains one of important activities of general surgeons in our country. Its morbidity and mortality remains fairly high in our precarious environments and surgical management is still relevant, especially indicated for hemodynamic instability and perforation of hollow organs.

**Keywords:** Abdominal trauma, hemodynamic instability, intra-abdominal re-bleeding, mortality

### Introduction

Trauma is still the most frequent cause of death in the first four decades of life, and it remains a major public health problem in every country, regardless of the level of socioeconomic development<sup>[1]</sup>. The abdomen is the third most common injured region, with surgery required in about 25% of civilian cases<sup>[2]</sup>. Globally, injuries from violence or accident are the second leading cause of death<sup>[3]</sup>; Trauma to the abdomen is fatal because of their risk of bleeding and septic<sup>[4]</sup>.

It is multidisciplinary, requiring significant resources and sometimes specialized centers<sup>[5]</sup>. Abdominal trauma (AT) is lesions produced at the level of the abdominal wall and/or its contents by an external agent. They can be opened, by rupture of the parietal continuity (abdominal wounds), or closed (abdominal contusions), respecting the parietal continuity, and

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responsible for visceral lesions (full or hollow viscera) which can be life threatening. They are a major public health problem due to their frequency and their consequences, because they have a high mortality rate of up to 25% to 27% [6, 7].

While the etiologies are multifactorial, road traffic accidents (RTA) are the mechanism most often at the origin of these lesions [4, 7, 8]. Their prognosis depends on the severity of abdominal lesions, associated extra-abdominal lesions and treatment efficiency [9].

In order to minimize mortality in cases of abdominal trauma, risk factors for mortality need to be systematically identified and studied. In recent years, studies have identified a number of such risk factors, including sex, the length of the interval between abdominal injury and surgery, shock at the time of admission, and cranial injury [1]. However, the absence of a medical system for collecting the wounded, the insufficiency of qualified personnel, a long duration of surgical intervention, and the low socio-economic level of the population, are also associated with this high mortality in our country [7].

In closed AT, hemodynamic state and signs of peritoneal irritation are the key elements of the therapeutic decision. Two approaches are opposed in the management of open AT: systematic laparotomy and selective abstention. The choice of the type of initial management depends on clinical and technical platform available [10].

The management of AT is therefore complex and must meet certain principles [11, 12]

It requires adequate diagnostic resources and technical platform, which are not always available in some limited settings like our own. In our country, Ultrasound and CT scans, although more and more frequently used, are not always accessible and/or available in emergency. Furthermore, interventional radiology and laparoscopy are not available in the majority of health structures [13] including those selected for this study. Thus, in case of failure/ non-indication of conservative treatment of patients with AT, an exploratory laparotomy remains the main management tool in our context.

The management of hemorrhagic abdominal trauma has evolved over the past 20 years. For the most severe cases, a shortened laparotomy or damage control surgery should be performed. It makes it possible to pass a critical acute course thanks to the realization of the rapid gestures, limited to the observation of the lesions and to summary gestures, to avoid the occurrence of a gradually irreversible coagulopathy [14-17].

Aims of this study were to determine the frequency, management and prognosis of patients with severe abdominal trauma in our context.

## Patients and Methods

We conducted a multi-center cross-sectional descriptive study with a collection of prospective data. It was carried out in the surgical departments of two hospital formations in Lubumbashi, namely, the University Clinic of Lubumbashi and the Janson SENDWE Hospital.

The sampling was exhaustive for convenience, including all cases of abdominal severe trauma that occurred during our study period, from January 2018 to November 2021. The severity was characterized first for abdominal contusions by the presence of signs of opening of the digestive tract (peritonitis) or the presence of blood in the peritoneal cavity evidenced either by the trans-parietal syringe puncture bringing back at least 5 milliliters of incoagulable blood, the frankly hematic peritoneal puncture washing or by an ultrasound of the abdomen; and secondarily for abdominal wounds by evisceration or a

penetrating wound of abdomen. The hemodynamic state was considered stable if the systolic blood pressure is less than 140mmhg and a normal pulse between 60 and 80 pulses per minute in a patient who has been resting for 10 to 25 minutes since admission [7]. It was unstable if the TAS is less than or equal to 90mmhg. The pre-shock state was defined for a TAS between 61 and 99mmhg with a pulse rate greater than 100 pulses per minute. The state of shock was defined for a TAS lower than 60mmhg with a pulse higher than 100 pulsations per minute which can be shooting or even imperceptible and if shock index (ratio of heart rate to systolic blood pressure) is lower than 0.7

We reviewed the operative and hospitalization's reports of these hospitals to identify all the patients treated by operating or not for an abdominal severe trauma over a 4-year period, from January 2018 to November 2021. Files were then consulted and the data mentioned on a pre-established questionnaire. Studied variables were: Patients' demographic, clinical and para clinical presentation, surgical findings and postoperative follow-up of the surviving patients was done until they were discharged from the hospital.

We excluded in our study, all cases of minor abdominal contusion (simple wall contusion), non-penetrating superficial parietal wound of the abdomen without any risk to the patient. Patients who died on arrival at the hospital without having been taken care of.

The study population include 93 patients hospitalized and treated in above-mentioned hospitals for severe abdominal trauma.

The information thus collected was entered in Epi info software 7.1.1.14 and Microsoft Excel 2013, processed and analyzed with Statistical Package for Social Sciences (SPSS) version 25; Chi-square, nonparametric and multiple logistic regressions tests were used to compare categorical variables; all other analyses relied on the independent *t*-test or one way analysis of variance (ANOVA). In all cases, we relied on a *P* value of <0.05. To check the homogeneity of distribution, the Levene and Kolmogorov-Smirnov tests were used, always taking into account the "p value ≤ 0.05"; to compare the medians between two variables, the Kruskal-Wallis and Wilcoxon tests were used and comparison of means was made with Anova test. Finally, logistic regression was used to retain exclusively the factors associated with poor prognosis.

The limitation in our study was that Injury Severity Scores (ISS) was not computed because it is not practiced routinely on all injured patients in our hospital.

The patients' free consent to participate in the study was obtained and the data were recorded on data collections sheets anonymously by assigning numbers to each patient.

## Results

During the study period, 2389 patients were managed in surgery service of the two medical units in Lubumbashi concerned by our study. Among them, 93 had been selected for our study; representing 3.89% of all surgical cases in our department.

The median age of the patients was 28.77 ± 13.83 years (extremes: 8 months and 68 years). The patients were young, seventy-nine (79) patients were at most 40 years old which represents 84.94% of cases. The majority of cases were recruited from university clinic in Lubumbashi (69.89%).

The male was in the majority (88.87%), with a sex ratio of 5.2; and the road traffic accident was the most common occurrence circumstance with 62.37% of the cases. The majority of patients resided in the annex commune (18 patients or 19.56%).

**Table 1:** Patient distributions according to sociodemographic data

Variable	Effective (N=93)	Percentage (%)	Statistical Parameters
<b>Age (year)</b>	<b>N(93)</b>	<b>Percent</b>	<b>Means</b>
0-10	10	10.75	28.77
11-20	9	9.67	Std Dev
21-30	39	41.93	13.83
31-40	21	22.60	Median
41-50	8	8.60	28
51-60	2	2.15	
> 61	4	4.30	
Total	93	100	
<b>Sexe</b>	<b>N (93)</b>	<b>Percent</b>	<b>Sexe ratio</b>
Female	15	16.13	
Male	78	83.87	5.2
Total	93	100	
<b>Recruitment location</b>	<b>N (93)</b>	<b>Percent</b>	
Lubumbashi university clinics	65	69.89	
Jason Sendwe hospital	28	30.11	
<b>Profession</b>	<b>N(93)</b>	<b>Percent</b>	
Military/police	3	3.22	
Motorcyclists'	13	13.98	
Vehicle driver	8	8.60	
housewife	5	5.37	
Non occupation	14	15.05	
State worker	8	8.60	
trader	15	16.12	
Pupil/student	27	29.03	
<b>Occurrence circumstance</b>	<b>N (93)</b>	<b>Percent</b>	
White weapon	4	4.30	
Road traffic accidents	58	62.37	
Domestic accident	3	3.23	
Work accident	2	2.15	
Fire arm	25	26.88	
Fall from a tree	1	1.08	
<b>Prehospital care</b>	<b>N (93)</b>	<b>Percent</b>	
yes	2	2.15	
no	91	97.85	
<b>Mode of transport</b>	<b>N (93)</b>	<b>Percent</b>	
Medical ambulance	4	4.30	
Taxi	73	78.49	
motorbike	16	17.21	

**Clinical features**

The median consultation time after trauma was 2 hours. At the first examination vital signs were recorded directly including the index shock. The mean systolic blood pressure was  $100.26 \pm 21.17$  mmhg with extremes of 00 and 154 mmhg; on the other hand, the diastolic one was  $62.51 \pm 13.75$  with extremes of 00 and 90 mmhg. The average shock index was  $1.03 \pm 0.34$  with extremes of 0.30 and 2.60. Majority of patients (47.31%) had a pulsed oxygen saturation between 90-95% (table 2). Abdominal

bloating was present in forty-eight patients (51.61%), abdominal defense in forty nine patients (52.69%), the coldness of the extremities in twenty-four patients (25.81%), Douglas sensibility in fifty-nine patients (63.44%) and crown of Douglas in seventy-two patients (77.41%). Sixty-one (61) patients had no associated lesions (65.59%) while the other thirty-two did, and were dominated by cranio-encephalic (9.68%) and thoracic lesions (8.60%).

**Table 2:** distribution of patients according to clinical data

Variables	Effective N (93)	Percentage	Statistical parameters
<b>Delay between trauma and consultation</b>			<b>Median (hour)</b>
Less than 1 hour	39	41.94	2.00
Between 1 and 2 hour	23	24.73	
Between 3-6 hour	19	20.43	<b>Mode (hour)</b>
Between 7 and 12 hour	5	5.38	1.00
Between 13-24 hour	4	4.30	
Between 25 -48 hour	2	2.15	
Beyond 48 hours	1	1.07	
<b>Type of trauma</b>			
Abdominal contusion	62	66.67	
Abdominal wound	31	33.33	
<b>General condition of the patient on admission</b>	<b>N(93)</b>	<b>percent</b>	

Good(preserved)	34	37.56	
Bad (altered)	59	63.44	
Hemodynamics state			
stable	40	43.01	
unstable	49	52.68	
unspecified	4	4.31	
Pulsed oxygen saturation(in percent)	N(93)	percent	
Normal (>95%)	26	27.95	
Low (insufficient 90-95%)	44	47.31	
Respiratory failure (<90%)	23	24.74	
Puncture	N(93)	percent	
Puncture peritoneal lavage	38	40.86	
Puncture transabdominal	23	24.73	
unrealized	32	34.41	

### Para clinic data

Hemoglobin and hematocrit, blood group and rhesus, bleeding time and clotting time were obtained in all our patients on arrival at the emergency. The mean baseline hemoglobin level was  $9.69 \pm 5.72$  mmhg with extremes of 4 and 13 mmhg and hematocrit  $27.20 \pm 6.87$  with extremes of 12 and 39 %. Echography was realized in 17 patients (18.28%) and the abdomen blank radiography in 4 patients (4.30%). For the two non-operated cases, the ultrasound was repeated for monitoring every 48 hours. No patient had performed an abdominal CT Scan.

### Therapeutics data

As soon as the patient with severe abdominal trauma arrives in the emergency room, a team made up of two surgical doctors, a senior and a junior evaluate it to judge the relevance of the start of resuscitation by the anesthetic team on duty. After the initial clinical examination, immediate resuscitation was initiated according to the hemodynamic state to maintain vital functions in all patients. In addition to resuscitation, all our patients with intra or extra abdominal lesions likely to be septic, benefited from antibiotic prophylaxis.

The median time between arrival to the hospital and the surgical management was 2.00 hours and the mode was 1.00 hours.

Ninety-one (91) out of Ninety-three (93) patients were operated (97.85%) while the two other patients (2.15%) were treated medically by armed expectations, by punctures, monitoring

peritoneal washings, ultrasound scan and monitoring of the hemoglobin level. Seventy-seven patients (82.79%) were transfused before surgical surgery, seventy-nine (84.94%) during surgery and only twenty-eight (30.10%) after surgery. The Principe of damage control surgery was applied in forty-four patients (47.31%). Concerning the liver wound, from the twenty-two cases, sixteen (72.72%) were treated by packing (perihepatic tamponade), five (22.72%) by suture and one (4.56%) by application of biologic glue. Concerning splenic rupture, one case was not operated, thirty-two cases were operated among which twenty-nine (87.87%) have had a total splenectomy, one respective case of partial splenectomy, suture of the spleen and application of biologic glue, equivalent to 3.03% each. All the lesions of the digestive tract were treated as a first –line treatment during laparotomy. We found nine intestinal lesions including six anastomotic resections and three intestinal sutures after resurfacing of the edges. We have recorded fourteen cases of mesenteric involvement divided into six cases of wounds and eight cases of hemorrhagic contusions. Wounds were sutured while for lesions from hemorrhagic contusions, surgical abstention was required. The two cases of wounds of the greater omentum were sutured immediately. Three renal damage encountered, two of which benefited from nephrectomy and one from which the hematoma was respected. Three cases of gastric damage including two perforations for which the procedures carried out were two sutures of the stomach and a gastric hematoma respected without touched it.

**Table 3:** Distribution of patients according to operative phase

Qualification of surgeon	Effective N (93)	percent
Junior assistant	4	4.40
Senior assistant	60	70.33
specialist	15	16.48
professor	12	13.19
Operating time	N (93)	Percent
Less than 1 hour	17	18.28
Between 1 and 2 hours	48	51.62
Between 2 and 3 hours	24	25.80
Beyond 3 hours	2	2.15
Non operated	2	2.15
Amount of fluid effused into the abdominal cavity( in milliliters)	N (93)	percent
<500	5	5.37
[500 – 1000]	23	24.73
[1000 – 2000]	39	41.93
[2000 – 3000]	15	16.12
>3000	9	9.67
Non operated	2	2.15
lesions encountered intraoperatively	Effective (N=91)	
Wound / Splenic rupture only	33	35.48
Liver wounds	26	27.95

Mesentery/mesocolic wound	23	24.73
Duodenal perforations	1	1.07
Jejunal perforation	7	7.52
Ileal perforation	4	4.30
Colonic perforation	2	2.15
Great omentum wound	2	2.15
Kidney wound	3	3.22
Diaphragmatic wound with hernia	1	1.07
Gastric perforations	8	8.60
Gastric hematoma without perforation	1	1.07
Hemorrhagic Contusion of the psoas	1	1.07
Section of the rectus abdominis	2	2.15
Traumatic Section of uterus	1	1.07
Rupture of the bladder	1	1.07
Abdominal lesions encounter to the abdominal echography	N=2	
Splenic wound	1	1.07
Hematoma gastric and mesentery	1	1.07

### Post-operative data and the period of hospitalization

Thirty-one patients (33.33%) did not have a stay in ICU while the sixty-two others (66.67%) went through intensive care on different days. Among these sixty-two, thirty-eight patients (40.86%) spent two days in intensive care, ten patients (10.75%) spent three days, twelve (12.90%) spent between four and seven days and two patients (2.15%) beyond seven days; the average stay intensive care was  $1.90 \pm 2.15$  with extremes of 0 and nine

days (table 4). The average hemoglobin level on the third post-operative day was  $10.7836 \pm 1.2858$  mg% and the fifth day it was  $11.28 \pm 1.11$  mg%. The evolution was good in sixty-seven patients among which sixty-five after surgery and the two no operated that represented sixty-seven good evolution on ninety-three (72.04%). The overall mortality was 23.65% (twenty-two patients); among which sixteen in closed abdominal trauma on sixty-two (25.80%) and six with abdominal wounds (19.35%).

**Table 4:** Post-operative evolution

Intensive care stay (day)	N (93)	percent
0(none)	31	33.33
1	16	17.20
2	22	23.66
3	10	10.75
Beyond 3days	14	15.06
Post-operative evolution	N (93)	Percent
Good evolution	65	69.90
Bad evolution	26	27.95
Non operated	2	2.15
Complications		
No complications	61	65.59
Complications(Morbidity)	32	34.41
Intraabdominal re-bleeding	9	9.67
Digestive fistula	6	6.45
Parietal infectious	5	5.37
acidosis	1	1.07
Pleural empyema	1	1.07
Acute renal failure	2	2.14
Death on operating table	2	2.14
Sudden death	3	3.22
Disseminated intravascular coagulation	1	1.07
Pulmonary embolism	2	2.14
Hospitalization period	N (93)	Percent
[0-7]	25	26.88
[8-14]	41	44.08
[15-21]	25	26.88
[21-28]	2	2.16
Issue	N (93)	percent
death	22	23.66
Discharge from hospital	71	76.34

**Table 5:** Assessment of risk factors of mortality factors

Factors	Chi-square test	DDL	Odds ratio	95% CI	"p-value"
Lesions encountered					
• Liver					
• Spleen	13.869	1	6.444	2.275 – 18.274	0.000*
• Mesenteric lesions	3.768	1	0.322	0.099 – 1.050	0.052 (NS)



• Others lesions	0.664	1	0.608	0.182 – 2.028	0.415 (NS)
Type of abdominal trauma	0.476	1	1.449	0.504 – 4.571	0.490 (NS)
Circumstance of occurrence	2.815	5	1.395	0.505 – 3.853	0.729 (NS)
Shortened laparotomy	0.07	1	0.960	0.367 – 2.506	0.933 (NS)
Amount of fluid shed in the abdominal cavity					0.00*
Operating time					0.32 (NS)
Age					0.49 (NS)
Index shock					0.00*
Interval between trauma and management					0.55 (NS)
Pulsed oxygen saturation					0.00*
Initial hemoglobin level					0.726 (NS)

NS: Non Significant

\*: Significant Association

Thus four factors were associated with a poor outcome, because the “p-value” was statistically significant ( $p \leq 0.05$ ): these were index shock ( $p=0.00$ ) pulse oxygen saturation ( $p=0.00$ ), amount of fluid effused in the abdominal cavity ( $p=0.00$ ) and the liver rupture ( $p=0.00$ ). Multimodal logistic regression with outcome and independent clinical variables as dependent variables was performed. After adjustment, two parameters proved to be determining factors in the morbid outcome: rupture of the liver multiplies the risk of death by 6 ( $\text{Exp (B)} = 5.57$ ) and non-application of damage control surgery (shortened laparotomy) which multiplies the risk of death by 1.4 ( $\text{Exp (B)} = 1.39$ ) although the difference was not statistically significant.

## Discussion

### Epidemiologic data

Abdominal trauma remains a major public health problem. They occupy an important place in the activities of emergency services. In our serial, abdominal trauma represented 3.89% of cases in surgery in our city. Our results superior to those found in Benin by Bio Tamou Sambo for whom abdominal trauma represented 1.1% of hospitalized patients and 10% of digestive surgical emergencies [18].

In the serial of Savom, They accounted for fifty-five point four (55.4%) of all trauma and more than half (54.6%) were operated [13]. Harouna found a rate of 9.89% of surgical emergencies in Niamey [19] while Allode in Parakou found that abdominal trauma represented 25.89% of surgical emergencies [20]. In the serial of Saleh [7], post-traumatic hemoperitoines operated represented 6.01% of all abdominal trauma with an average of 18.5 cases per year. For Vignon *et al.* [21], the frequency was 13 cases / year and 1.8% of the hospitalized patients. Our results are close to those found everywhere else, which demonstrates the importance of this nosological entity for the health of our populations.

### Sexe of patients

The male sex represented 83.87% of cases. Almost all studies are unanimous on the male predominance of abdominal trauma of course at different frequencies [2, 4, 6, 7, 18].

This could be explain on the one hand by the fact that the man is the most inclined to promote the needs on the family and therefore finds himself more on the public road for work then for work then women are more housewives in our culture but also the high risk behavior of the male sexe on the public highway.

### Age of patients

The majority of abdominal trauma patients are young. In our series, the most affected age group was between 21 to 30 years old with 41.93% of cases; the average age was  $28.77 \pm 13.83$ , same like Tamou [18] who has found  $28,04 \pm 22,25$ . And almost

the majority of authors are unanimous on the fact of abdominal trauma is encountered much more in young people [2, 7, 8, 13]. The predominance of young people could be explained by early involvement of children in socio-professional activities, the low educational level of young people who find themselves on the public road as motorcyclists.

### Recruitment location

Depending on the place of recruitment, the university clinics of Lubumbashi constituted the largest part of our sampling site with 69.89% of cases. This is explained by the fact that it is our permanent place of service and the ease of monitoring all patients with severe abdominal trauma and carrying out all the examinations by ourselves on a day-to-day basis.

### Profession

The category student/pupil was the most represented in our study with 29.03% of cases followed by trader workers with 16.12%. These are the categories of people who are constantly on the public road and therefore indirectly who are the most exposed to trauma. Pupils/students were the most represented professions in Saleh's study [7] like in our study but followed by the motorcyclists whereas with us, it was the traders.

### Occurrence circumstance

Road traffic accidents remains the most important cause of trauma and especially closed abdominal trauma. In our case, it had represented 62.37% of cases. The trauma by road traffic accident is no longer to be questioned as there are publications which demonstrate it [4-7, 21, 22]. The low frequency of open abdominal trauma which represented in our series 26.88% for fire arm and 4.30% for white weapon is explained by the rarely of stabbing attacks and the non-legal carrying of firearms, explaining that there are only soldiers or police who are authorized to carry these weapons. This is why in USA the etiologies of abdominal trauma are more frequently violent, by firearm or stabbing (60%) [23]. In Europe and outside the war zones, traumas occur in more than 60% of cases during road accidents [5] as in our case. A recent WHO report describes road injuries as an extremely serious epidemic, because they are responsible worldwide for 1.2 million deaths per year: in fact, while mortality from road accidents tend to decrease in Europe and the USA; it is only increasing in less wealthy countries due to anarchic development of automobile traffic. 90% of deaths from road accident worldwide occur among injured people living in low-and middle-income countries [24].

### Clinical data

All our patients had arrived in urgent context. The majority of them or thirty-nine patients (41.94%) arrived at emergency room within an hour, twenty-three among them (24.73%) between one

and two hours, six (6.45%) within two and three hours, and the thirty-one(31) others (33.33% of cases) beyond six hours; The median delay consultation was 2.00 hours and the mode was 1.00 hour. Hama Y. in Niamey (Niger) found 18hours, but far greater than that of Los Angeles which was 18 minutes thanks to its "trauma system" [25]. The lack of a well-structured and functional emergency medical aid service in most African countries and in ours, could explain these long admission delays. Indeed, the majority of our patients is taken to emergency departments by non-medical means, most often in personal or transport vehicles [13]. This is really observed also in our study where 78.49% of patients were taken to hospital in taxi, while the medical ambulance was only used in four patients (4.30%).

When the patients arrives at the hospital, treatment is started immediately. A combined assessment of the surgeon on duty on duty and anesthesiologist; and the decision to operate or not is then made in the case of abdominal closed trauma. But for the open abdominal trauma, concerning firearm, the surgery is obligatory; Gunshot wounds result in often multiples visceral lesions which must be investigated by exploratory laparotomy, as in our case. One the other hand, for stab wound, also gunshot abdominal wound, some recommend a selective abstainer ; as prone by Shaftan [26] to avoid white laparotomy [27, 28] and only operate on patients with obvious visceral lesions, subject to armed surveillance [27-29]. For operative cases, the time interval between consultation and operation ranged from a few minutes to a few hours. In our series, three patients (1.23%) were operated less than 1 hour, twenty-seven patients (29.03%) within one hour, twenty-three patients (24.73%) in two hours, seventeen patients within three hours, fifteen patients (16.13%) within four hours and the rest of eight patients (8.6%) only beyond four hours. In the study of Raheerintanaina [8], the delay in taking charge was also included in the first six hours (83.6%) also in the study of Ayité and Bombah [27, 28] majority of patients were treated within six hours of trauma with respective frequencies of 86.4% and 70.2% like in our study.

The taxi was the most used mode of transport with 78.45% of cases. According to Bombah [28] in Cameroon, the emergency health system, evacuation and ambulance being compromised by the density of the city, the state of roads, patients are generally taken by public transport or police car; this is specific to developing countries.

Concerning clinical examination, it should be noted the hemodynamic state and the existence of signs of peritoneal irritation are the key elements which should guide the management [6, 30]. The general state was normal in thirty-four patients (36.56%) and was altered in fifty-nine patients (63.44%).

Shock index was within normal limits in thirty-five patients (37.63%), under the limits in ten patients (10.75%) and over the superior limit in forty-eight patients (51.61%). The average chock index was  $1.03 \pm 0.34$  for the extremes of 0.3 and 2.6.

In our study, abdominal Contusions has represented 66.67% of cases while open abdominal trauma constituted 33.33 % of cases, Tamou [18] found 74.50% of abdominal contusion and 24.50% of open abdominal trauma; which confirms predominance of closed trauma over open trauma of the abdomen.

Fifty-two point sixty-eight percent (52.68%) was hemodynamically unstable at the arrival to the hospital while twenty-seven point zero two percent (27.02%) were considered stable upon admission. In Saleh's series [7], fifteen patients or 40.54% were hemodynamically unstable and Vignon and col. [21], reported an unstable hemodynamic state in 62.2% of cases.

Majority of patient (47.31%) of patients had a pulsed saturation in oxygen low between 90-95%. The mean pulsed oxygen saturation was  $90.34 \pm 8.0264\%$  for the extremes values of 45 and 99%.

In our study, the puncture peritoneal lavage were realized in 40.86% of cases while the trans parietal puncture was performed in 24.73% of patients. In the study of Vignon *et al.* [21], the trans parietal peritoneal puncture confirmed the diagnosis in 58.3% of the cases while in that of Tamou, it was carried out in 11.25% of cases [18].

Abdominal bloating was present in forty-eight patients (51.61%) while defense was noted in forty-four patients (47.31%).

Cold extremities indicative of hypovolemic shock was noted in twenty-four patients (25.81%), absent in fifty-eight patients (62.37%) and not reported in eleven patients (11.83%).

Douglas was tender in fifty-nine patients (63.44%) and bulging in sixty-two patients (66.66%).

### Para clinical data

Hemoglobin and hematocrit, blood group and rhesus were obtain in all our patients on arrival at the emergency room. The mean baseline hemoglobin level was  $9.69 \pm 5.72$  mmhg with extremes of 4 and 13 mmhg and hematocrit  $27.20 \pm 6.87$  with extremes of 12 and 39 %. Concerning blood group, the majority of patients (21.74%) were of the 0+ group blood. Echography was realized in seventeen patients (18.28%) and the abdomen blank radiography in four patients (4.30%). For the two non-operated cases, the ultrasound was repeated for monitoring every 48 hours. In the Bombah study [28], the para clinic examinations performed were the unprepared abdominal X-ray, chest X-ray, abdominal pelvic ultrasound, as the some with in our study. However, computed tomography remains the gold standard in open trauma to the abdomen with an estimated sensitivity of 80% followed by standard ultrasound and radiography [30]. Tamou who walked on abdominal trauma in Benin [18], also found in his study that outside the clinic, the abdomen without preparation (7.74%), and abdominal ultrasound in thirty-seven patients (37.76%). However in Morocco, which is a more developed country than ours, abdominal trauma was performed urgently in all patients (100%) and an abdominal CT scan in 53.7% of patients [31]. The low rate of performing ultrasound is explain by, the one hand, the obligation to pay the costs of para clinical examinations, the majority of patients having no money available and, on the other hand, by the absence of imaging technicians during on-call at our two university hospital institutions when the majority of patients arrived mainly at night; which would delay this urgent care in our often deprived patients. The absence of the scanner at the university clinics of Lubumbashi explains the absence of a scanner in this urgent situation.

### Therapeutics data

Out of ninety-three patients with abdominal trauma among which sixty-two cases of abdominal closed trauma, only two in our series had not been operated (2.15%), which is an extremely low rate compared to that of Khalid who recorded a non-operative treatment in ninety-six patients (90.6%) and who had only ten patients (9.4%) of emergency laparotomy and three other secondary laparotomy (3%) out of a total of one hundred six patients [31].

Emergency surgery remains the rule in abdominal trauma patients whose hemodynamics remains unstable despite well-conducted resuscitation, or in the event of obvious lesions of hollow organs [31]. Midline laparotomy will be preferable in this

case. The shortened laparotomy corresponds to the realization of a gesture as fast as possible and therefore incomplete, limited to the observation of lesions and a summary control of an active hemorrhagic and/or digestive fistula, followed by the closing of the laparotomy to make room for resuscitation that is needed [32]. At the same time, some recent study reveal the success of conservative treatment in abdominal contusions in adult. It is possible in 55 to 80% of cases with a success rate of around 60 to 70%, with a view to reducing surgical interventions, and thus increase the chances of preserving solid organs, with the possibility of intervening secondarily, to allow less invasive management of abdominal trauma [33].

Three organs were most affected: the spleen, the liver and the meso, especially in closed trauma while in open trauma, intestinal lesions were the most affected. This is confirmed by the study of Nicholas which affirms that in case of trauma penetrating the abdomen (independent of the mechanism) concern in order of growth the small intestine, the colon and the liver [34] and the study of Bombah in which the most affected organ was the small intestine in eighteen (50%) of operated patients, the colon in five (14%) of patients and the stomach in four (11.1%) of patients [28].

Concerning the liver wound, on twenty-six cases, sixteen (61.53%) were treated by packing (perihepatic tamponade), five (19.23%) by suture, one (4.56%) by application of biologic glue and four (15.38%) by suture combined to perihepatic tamponade. Concerning splenic rupture, one case was not operated, thirty-two cases were operated among which twenty-nine (87.87%) have had a total splenectomy, one respective case of partial splenectomy, suture of the spleen and application of biologic glue, equivalent to 3.03% each. All the lesions of the digestive tract were treated as a first –line treatment during exploratory laparotomy. Depending on the type of intestinal lesions observed intraoperatively, some were simply sutured with or without resurfacing the edges, but in some patients, anastomosis resections were performed directly as a first-line treatment.

### Evolution data

The mean stay hospitalization was in our study  $10.87 \pm 6.27$ , this being explained by an old regulation of the department where the patient is released on the 10<sup>th</sup> post-operative day, the day of the second dressing of the operative wound with section of the skin sutures in the event of non-complication of the laparotomy. Savom [13] also has found  $9.7 \text{ days} \pm 12.3$ , value lose to ours. The average length of hospitalization was approaching that of our African colleagues [35–37]. The difference in the long stay hospitalization between our study and that of Saleh which was only carried out only in Sendwe is explained by the fact that in Sendwe, which receives a much more indigent population than at university clinics. The patients are therefore retained even after recovery for administrative formalities, unnecessarily lengthening the hospital stay of the patients but also our study is a longitudinal and prospective descriptive study with a good daily monitoring of patients by our team, whereas Saleh's study was described across the board with retrospective data collection and older than ours.

The morbidity was noted in 32 patients in all (34.41%). The most complication recorded was the re-bleeding in nine patients (9.67%) followed by digestive fistula in six patients (6.45%) and wall infection in five patients (5.37%). Surgical site infections are the main complications in the Savom's study [13]. This rate is higher than that of Ndong in Senegal who found a morbidity of 5.4% in all [35], this is partly due to the fact that in them the

majority of patients were hemodynamically stable compared to ours.

Overall mortality in our study was 23.66%; this rate is relatively high, but in the study of Mohammad A Gad, in Egypt [35], the overall mortality rate among abdominal trauma patients in our series was 25.8%, which is relatively high. Mortality was significantly higher with penetrating trauma patients than with blunt trauma (57.9% vs 11.6% respectively,  $P$  value  $<0.05$ ) in Mohammed Gad's study. In our study among the 22 deaths, 16 were from abdominal contusions (25.80%) and 6 from abdominal wounds (19.35%). Other investigators [38] have reported much lower mortality rates of 9.2% and 8.2% in penetrating and non-penetrating injuries, respectively. The factors associated with mortality in our study are hepatic damage ( $p=0.000$ ), amount of blood shed ( $p=0.000$ ), high shock index ( $p=0.000$ ).

The high rate of deaths among open trauma victim of the abdomen would certainly be explained by several factors, among others the multiplicity of organ damage in trauma by firearm, but also to underline the lack of policy of surgical damage control in trauma severe abdominals not yet popular in our department, where because of the cost of surgical operations not subsidized by the state, we prefer to perform long operations at once and correct all the lesions to avoid a second operation, often difficult to pay by the sick. However, the logistic regression allowed us to retain only two factors: hepatic rupture and failure to apply damage control.

### Conclusion

Abdominal trauma remains a major concern around the world, both in the most industrialized countries and in the developing world. In Lubumbashi, mortality is still high among a young population, mostly under 40 years old. The initial clinical evaluation remains the cornerstone of hospital management. The dogma of the exploratory laparotomy of open abdominal trauma is no longer up to date in favor of the concept of selective absenteeism and the radical principle of surgical damage control during surgery is globally recognized and applied throughout the world.

### Conflicts of interest

The authors do not declare any conflict of interest.

### What is known about this subject?

- Abdominal trauma is a major public health concern.
- Two major problems associated with abdominal trauma, it is the hemorrhage by attacks of fully viscera which engages the vital prognosis in the short term and infectious by attacks of the hollow viscera in the medium term

### What does our study bring new?

- Epidemiological data of open and closed abdominal trauma in Lubumbashi
- Our study will serve as basis for knowledge of the principles of damage control in our hospitals in severe abdominal trauma
- Fours factors are associated with a fatale outcome, two of which were retained as the most decisive after logistic regression, namely liver rupture and non-application of damage control.

### Author contributions

All authors contributed to the development of the article.

All had read and approved the final version before submission.



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