Management and outcome of 308 cases of liver trauma in Bologna Trauma Center in 10 years

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INTRODUCTION: *Management of Liver Trauma may vary widely from NOM ± angioembolization to Damage Control Surgery. Multidisciplinary management is essential for achieving better outcomes.*
MATERIAL AND METHODS: *During 2000-2009 period 308 patients with liver injury were admitted to level 1 trauma center and recorded in Trauma Registry. Collected data are demographics, AAST grade, initial treatment (operative or non-operative treatment) and outcome (failure of NOM), death. All patients were initially assessed according to ATLS guidelines. In case of haemodynamic instability and FAST evidence of intra-abdominal free fluid, the patients underwent immediate laparotomy. Hemodynamically stable patients, underwent CT scan and were admitted in ICU for NOM.*
RESULTS: *Two hundred forteen patients (69.5%) were initially managed with NOM. In 185 patients this was successful. Within the other 29 patients, failure of NOM was due to liver-related causes in 12 patients and non-liver-related causes in 17. Greater the grade of liver injury, fewer patients could be enrolled for NOM (85.8% in I-II and 83.3% in III against 39.8% in IV-V). Of those initially treated non-operatively, the likelihood of failure was greater in more severely injured patients (24.4% liver-related failure rate in IV-V against the 1.3% and 1.0% in I-II and III respectively). Onehundred twentythree patients (40% of the whole population study -308 patients-) underwent laparotomy: 94 immediately after admission, because no eligible for NOM; 29 after NOM failure . In the 81 patients in which liver bleeding was still going on at laparotomy, hemostasis was attempted in two different ways: in the patients affected by hypothermia, coagulopathy and acidosis, perihepatic packing was the treatment of choice. In the other cases a "direct repair" technique was preferred. "Early mortality" which was expected to be worse in patients with such metabolic derangements, was surprisingly the same of the other group. This proves efficacy of the packing technique in interrupting the "vicious cicle" of hypothermia, coagulopathy and acidosis, therefore avoiding death ("early death" in particular) from uncontrollable bleeding.*
CONCLUSION: *NOM ± angioembolization is safe and effective in any grade of liver injury provided hemodynamic stability. DCS is Gold Standard for hemodynamically unstable patients.*

KEY WORDS: Damage control surgery, Liver trauma non operative management, Peripheratic packing, Trauma Center.

Introduction

Because of its size and the relatively fragile parenchyma, the liver is one of most frequently injured abdominal organ, in traumatic events: it follows the bowel and the spleen in penetrating and in blunt injuries respectively [1-4]. Not surprisingly the scientific community have made every

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effort in finding the best treatment for these traumatic injuries.This has led to significant changes in liver trauma management, consistent with an impressive improvement in outcomes, especially over the last two decades [5-7]. One of the most remarkable ones surely is Non Operative Management (NOM): firstly described in 1972 [8], NOM has been stimulated by the evidence that 50–80% of liver injuries stop bleeding spontaneously, and by its success in children [9-11]. The significant development and refinement of liver imaging with CT scanning combined with more extensive use of interventional radiological techniques have increased NOM success rate, from 68 to 87% according to the various studies [12-16]. Initially introduced for minor injuries, NOM has been adopted for more severe injuries too (grades III–V), with similar remarkable results [17-19]. Nevertheless, concerns regarding safety of NOM still remain [20], even though the failure rate seems to be low. This study aims to show that NOM with the adjunct of angioembolization is safe and effective in any grade of liver injury provided hemodynamic stability. When bleeding from liver trauma affects hemodinamic stability, surgical treatment is still mandatory. Hemostasis could be achieved in two different ways: by direct repair of the bleeding lesions (such as hepatorrhaphy, hepatotomy and selective vascular suture or ligation [21,22]; anatomical [23] and non-anatomical resection[24], major vessels repair before vascular exclusion) or by Damage Control Surgery [25-26] (DCS). DCS consists of three different phases: the first one involves the rapid control of hemorrhage and contamination through liver packing and suture of bowel perforations; operation ends with temporary abdominal closure. The second phase, which takes place in the Intensive Care Unit for 24-48 hours period, has the purpose of restoring normal physiological parameters such as core temperature, pH, coagulation and so on. The third phase consists of a planned reoperation with anatomic, definitive repair and fascia closure. DC surgery is a resuscitation effort intended to try breaking the "bloody vicious cycle" of hypothermia, acidosis and coagulopathy which is often found in the severely injured patient [27] accounting for incredibly high mortality. DCS has been initially described by Halstead in 1908: it consisted of packing for uncontrollable bleeding from the liver. It was widely adopted especially in the military trauma setting of Second World War. Decline of this technique followed, because of the high risk of infection and sepsis from bacterial colonization of abdominal packs in pre-antibiotic era. Morever, in the 60' and the 70', a more detailed knowledge of liver anatomy, led surgeos attempt direct hemostasis through one-stage operation [28-29]. Experience demonstrated that this traditional approach of operating until the surgery is definitively finished resulted in ongoing bleeding and unresuscitatable shock from coagulopathy, acidosis and hypothermia; if not in the early going, death invariably occured later because of multiple system organ failure [30-31]. Therefore, from the 80', various Authors became to restore DCS and liver packing reputation: Stone [32] in 1983 suggested aborting a laparotomy with intra-abdominal packing when nonmechanical bleeding developed due to coagulopathy. Burch [33] selected packing for exanguinating hepatic injuries, showing an improvement in survival rate. In 1993, Rotondo and Schwab [34] provided the description of "damage control" and the definition of its different stages, along with improved outcomes. Because of the better survival rate registered, damage control has been expanded to extra-abdominal injuries, such as thoracic, extremity vascular and orthopedic injuries [35-36]. Recently, Filicori e coll[37] adopted DCS in patients with uncontrollable bleeding not related to traumatic lesions, provided that they were affected by the same metabolic derangements (acidosis, coagulopathy and hypothermia) of trauma patients: results demonstrates that Non Traumatic DCS (NT-DCS) seems to be feasible, safe and effective. It was soon clear that damage control measures should be implemented as early as possible [38] in the patient's course to achieve maximal benefit. Nevertheless, for long time, only subjective data were available to guide clinicians in the choice of damage control technique to the appropriate patient. This work outlines that core temperature less then 34 °C, pH< 7.1 and PT PTT >50% of the normal lab value are the cornerstones of this surgical decision-making: at present knowledge, application of DCS in presence of this specific metabolic pattern guarantees the best results.

Materials and methods

All the patients sustaining hepatic injury during a 10 years period, from January 2000 to December 2009, were selected from our Hospital Trauma Registry.
The collected data were: demographics (sex and age), mechanism of injury (blunt or penetrating), hepatic injury grade (according to AAST Liver Injury Scale [39]), associated injuries, type of treatment chosen on patient admission (non-operative or operative treatment) and its outcome (success or failure of non-operative treatment), length of hospital stay, death.
For the patients sustaining a III-IV-V AAST hepatic injury, the data collected included also vital signs (cardiac rate, breathing rate, systolic blood pressure), serum lactate, base excess, pH, infusion requirements (packed red blood cells, fresh frozen plasma, colloids and crystalloids), Injury Severity Score (ISS), Glasgow Coma scale (GCS) and Revised Trauma Score (RTS).
All the injured patients were initially assessed and managed according to Advanced Trauma Life Support guidelines [40]. Patients who were hemodynamically stable either at admission or after low-volume crystalloid infusion, underwent a CT scan and then were admitted in ICU for non-operative treatment. Hemodinamic stability, as outlined by Veroux M [41] was defined by systolic blood

pressure greater than or equal to 90 mmHg, or by serum lactate less than 5 mmol/L and Base Excess more than -5 mmEq/L. NOM was discontinued by surgical operation if any sign of hemodynamic instability or peritonitis or injury requiring repair was detected.
In case of haemodynamic instability and evidence of intra-abdominal free fluid at abdominal ultrasonography (FAST), the patients underwent immediate laparotomy, without any other imaging study. Operative treatment was also chosen in case of hemodynamically stable patients with peritonism, or CT findings of hollow or solid organ injury requiring surgical repair.

Results

During the 2000-2009 study period 2190 patients with abdominal trauma were admitted to our level 1 trauma center in Bologna. Of these, 308 patients had a liver injury (Table I).
Mean age was 37,3 (range 3-94), and male / female ratio was 2.20/1.
Blunt trauma was the most frequent mechanism of injury (86,6%), penetrating injuries accounting for the remaining 13.4%.

IMMEDIATE SURGERY GROUP

Ninety-four patients (30.5%) underwent immediate surgery: this was because 63 patients (67.0%) were hemodynamically unstable. In the remaining 31 patients the indication for immediate operation was CT finding of abdominal organ injury requiring surgical repair: bowel injuries in 12 patients (12.7%); kidney, pancreas, urinary bladder, diaphragm injuries in 13 patients (13.8%); in 6 patients the laparotomy, which was performed because of clinical peritonitis or penetrating injuries, was non-therapeutic (Table II).

NON-OPERATIVE MANAGEMENT GROUP

Twohundred forteen patients (69.5%) were initially managed with non-operative treatment. As the next table shows, greater the grade of liver injury, fewer patients could be enrolled for non-operative treatment (85.8% in I-II and 83.3% in III against 39.8% in IV-V liver injury) (Table II). In 185 patients NOM was successfully carried out (Table III).

NON-OPERATIVE MANAGEMENT FAILURE GROUPS

Regarding the other 29 patients, the failure of non-operative treatment was due to liver-related causes in 12 patients and to non liver-related causes in 17.
"Liver-related" NOM failure was due to haemodynamic instability in 11 patients and to celiac trunk abnormalities impairing successful embolization in 1 patient with CT evidence of "vascular blush" within the liver.
The causes for dropping the non-operative management in the "non-liver-related" failure group (17 patients) were

TABLE I - *Demographic data, mechanism of injury and mortality in the whole study population and in three, conventional, sub-groups (I-II AAST; III AAST; IV-V AAST).*

Grade of Injury (AAST)	Number of cases	Average age	Male/female	Blunt hepatic injury	Penetrating hepatic injury	Mortality
I-II	85	36.0	60/25	80	5	5 (5.8%)
III	120	36.9	87/33	105	15	6 (5,0%)
IV-V	103	39.0	65/38	82	21	36 (34.9%)
Total	**308**	**37.3**	**212/96 (2.20/1)**	**267**	**41**	**47 (15.25%)**

TABLE II - *Different treatment undertaken (surgery or NOM) at patients admission.*

Number of patients Grade of injury		Immediate surgery	Non-operative treatment
I-II	n= 85	12	73 (85.8%)
III	n= 120	20	100 (83.3%)
IV-V	n= 103	62	41 (39.8%)
Total	**n= 308**	**94**	**214**

TABLE III - *NOM treatment: lower rate of NOM success in the groups with bigger AAST grade.*

Number of patients Grade of injury		Immediate surgery	Non-operative treatment	Successful non-operative treatment
I-II	n= 85	12	73	63 (74.1%)
III	n= 120	20	100	97 (80.3%)
IV-V	n= 103	62	41	25 (24.2%)
Total	**n= 308**	**94**	**214**	**185 (60.0%)**

TABLE IV - *"Liver-related" and "non liver-related" NOM failure by AAST injury grade.*

Number of patients Grade of injury		Immediate surgery	Non-operative treatment	Failure non liver-related	Failure liver-related
I-II	n= 85	12	73	9	1 (1.3%)
III	n= 120	20	100	2	1 (1.0%)
IV-V	n= 103	62	41	6	10 (24.4%)
Total		**94**	**214**	**17 (7.9%)**	**12 (5.6%)**

TABLE V - *Comparison between physiologic parameters and ISS registered in the patients who had unsuccessful and successful NOM.*

Parameter	Successful non-operative (n= 185)	Liver-related failure (n= 12)
Mean Systolic BP	128.7	107.7
Mean Base Excess	-3.5	-6.4
Mean serum lactate	3.8	5.4
Mean ISS	20.7	29.6

solid organ injuries (spleen, pancreas, kidney) in 6; bowel injury in 5; urinary bladder injury in 2; diaphragmatic injury in 1; non-liver bleeding source which angiographic embolization cannot stop in 2; finally, in 1 case, the laparotomy was non-therapeutic.

Next table (Table IV) highlights the fact that, of those initially treated non-operatively, the likelihood of "liver-related" failure and subsequent need of surgery was greater in patients with higher grades of liver injury (24.4% "liver-related" failure rate in IV-V against the 1.3% and 1.0% "liver-related" failure rate in I-II and III respectively).

These patients in whom nonoperative management failed had significantly worse admission parameters and an higher ISS if compared wit**h the group of patients successfully treated non** operatively (Table V).

This let us suppose that non-operative treatment failure is due to injury severity other than low efficacy of NOM. Moreover, while in the "immediate surgery" group the mortality rate becomes bigger as the grade of liver injury increase (16.6% and 20.0% in I-II and III respectively against 56.4% in IV V), this trend cannot be observed in the "non – operative" group (5.4% and 1.0% in I-II and III respectively against 2.4% in IV V) (Table VI). This demonstrates the safety of non operative management: the bigger failure rate in the patients, non-operatively treated, with more severe liver injuries, doesn't correlate with higher mortality rate.

The safety and efficacy of non-operative treatment becomes evident if we look at the sensible reduction of mortality in the last five years (2005-2009) of the study period. This correlates with the greater rate of successful non-operative treatment (53.3% against 67.5%). The better outcome could be referred to more extensive use angiography embolization in the multimodal treatment of liver injury (Table VII).

OPERATIVE PROCEDURES

One hundred-twenty-three (123) patients underwent surgical treatment: 94 of these belong to the "immediate surgery" group; the remaining 29 underwent surgical treatment after the failure of the non-operative one.

36 patients didn't require any hemostatic procedure to

TABLE VI - *Death rate by grade in the "immediate surgery" and in "non-operative management(NOM)" group.*

Grade of injury	Immediate surgery		Non-operative treatment	
	Number of deaths	Number of patients	Number of deaths	Number of patients
I-II	2 (16.6%)	12	3 (4.1%)	73
III	4 (20.0%)	20	2 (2.0%)	100
IV-V	35 (56.4%)	62	1 (2.4%)	41

TABLE VII - *Comparison between the first five years of the study period (2000-2004) and the last ones (2005-2009).*

Period of years	Number of patients	Number of deaths	Successful non-operative treatment
2000-2004	163	36 (22.0%)	87 (53.3%)
2005-2009	145	11 (7.6%)	98 (67.5%)
Total 2000-2009	308	47	185

liver: this was because, in 26 cases, the bleeding from the liver was already stopped; in 10 cases because the bleeding source was from elsewhere than the liver.
5 patients with V AAST liver injury and 1 patient with III AAST liver injury, needed liver hemostasis but died, in the operating room, before any procedure could be done.
81 patients (65.8%) required at least one surgical procedure to the liver: in 16 patients the hemostatic procedure used was minor and consisted in coagulation of bleeding vessels by electrocautery or by argon-bean and in application of hemostatic topical agents, like fibrin glue, to enhance clotting; 27 patients required deep suture of parenchymal lacerations and suture ligation of bleeding vessels. Finally, the other 38 patients, of the 81, required complex maneuvers to achieve hemostasis: in 3 patients atypical resection was performed; in 1 patient right lobectomy and in 34 patients perihepatic packing. This one was performed predominantly (12 patients) according to a new tecnique [42] which was implemented at our Institution since 2005: after complete mobilization of the right lobe by sharp dissection of the falciform, right triangular and coronary ligament, a total number of 8 folded laparotomy gauze, coated with topical hemostatic agents, are placed in pairs all around the posterior paracaval space, the lateral right side, the anterior surface and the posteroinferior visceral surface of the liver. The diaphragmatic surface remains free to avoid unduly elevation and respiratory compromise. It has to be outlined that packs are placed around the posterior paracaval space, carefully avoiding any ICV compression.
Of the 22 patients with I-II AAST liver lesion which underwent laparotomy ("immediate surgery" + "non-operative failure" groups), only 9 patients (40.9%) required liver hemostatic procedures. These were the "minor" ones: coagulation of bleeding vessel and hemostatic topical agent application in 4; deep parenchymal suture and suture ligation of vessels in 5.
Of the 23 patients with III AAST liver lesion which underwent laparotomy ("immediate surgery" + "non-operative failure" groups), in 13 (in 56,5%) patients there was a liver source of bleeding requiring hemostasis: in 1 case a non-anatomic parenchymal resection was performed; 1 patient required a perihepatic packing; in the remaining 11 patients only "minor" hemostatic procedure were necessary.
Among the 78 patients with IV-V AAST liver lesion ("immediate surgery" + "non-operative failure" groups) which underwent laparotomy (considering only the first operation in the patients which were operated multiple times), 59 hemostatic procedures (75.6%) were performed. These consisted of minor procedures only in 22 patients; in 2 patients a non-anatomic parenchymal resection was performed; in 1 patient an anatomic lobectomy was necessary. In 34 patients perihepatic packing was mandatory.
As the table shows (Table VIII), patients with less severe hepatic injury, were more unlikely to require an hemostatic procedure (36.6% in I II AAST grade against 24.3% in IV V AAST grade): in most of these cases, bleeding was already stopped.
Another interesting issue comes out of next table (Table IX): it shows the differences between the two groups in which the 81 patients, requiring an hemostatic procedure, could be devided. In the 47 patients group, hemostasis was attempted by "direct repair" techniques: deep suture of parenchymal lacerations; suture ligation of bleeding vessels; anatomic and non anatomic parenchymal resections; right or left lobectomy. In 34 patients, bleeding from the liver was faced by peri-hepatic packing.
The "lethal triad"of hypothermia, coagulopathy and acidosis was more frequently affecting the patients treated by packing. As outilined by Moore E. [27], lethal triad leads to death from uncontrollable bleeding, therefore increasing "early mortality" (bleeding kills quickly). The data registered show that packing was able to reduce "early mortality" which, for that matter, doesn't exceed the no-lethal-triad "early mortality" group (32.3% against 31.9%). This highlights efficacy of perihepatic packing in stopping bleeding in patients with metabolic failure.

Discussion

Over the past decades, one relevant advance in liver trauma treatment has been registered: routine application of non-operative management (NOM) in selected patients. It consists of strict clinical observation until any necessary surgical treatment is ruled out and spontaneous healing allows safe dimission. The suitable setting could be either the Surgery Ward or the ICU, depending on trau-

TABLE VIII - *Surgical treatment group (n=123): to be noticed that patients with less severe hepatic injury, were more unlikely to require an hemostatic procedure*

AAST grade		No hemostatic procedures required	Liver hemostatic procedure required, but not performed because of death occurrence	Hemostatic procedure required
I II	(n= 22)	8 (36.3%)	5	9 (40.9%)
III	(n= 23)	9 (39.1%)	1	13 (56.5%)
IV V	(n= 78)	19 (24.3%)	0	59 (75.6%)
total		**36**	**6**	**81**

TABLE IX - *Patients requiring hemostasis from liver-related bleeding: different surgical approaches used.*

	Liver hemostasis performed by packing	**Liver hemostasis performed by direct-repair techniques**
Total number	34	47
Gender (male/female)	21/13	28/19
Mean age	39.7	32.9
AAST Grade III IV V	1 (III) 26 (IV) 7 (V)	1 (III) 37 (IV) 9 (V)
n° and % of hypothermic patients (body temperature 34°C)	7 (20.5%)	6 (12.7%)
GCS in ICU	10.4	10.9
ISS	37.4	36.2
NISS	44.0	39.1
RTS	5.85	5.75
Systolic pressure (mmHg)	81.0	90.3
Breathing rate	20	21.5
Base Excess	-11.36	-4.5
pH	7.1	7.33
TRISS	0.628	0.661
PT seconds (normal values: 11-13.5)	23.7	12.5
aPTT seconds (normal values: 26-35)	50.7	35
Plt (normal value: 150 – 450 x 10^9)	163 x 10^9/L	289 x 10^9/L
Fibrinogen (150 – 450 mg/dL)	143	150
PRBC units (first 24 h)	15.6	13.8
FFP ml (first 24 h)	2810 (circa 9.3 Units)	2190 (circa 7.3 Units)
PRBC/FFP units ratio	1.6	1.9
Pre hospital resuscitation fluids (ml)	1310	1510
Emercency Room resuscitation fluids (ml)	1533	1610
Whole fluid infusion (pre-H + E.R.)	2843	3120
Embolization	8 (23.5%)	9 (19%)
Number of deaths (mortality)	19 (55.8%)	22 (46.0%)
Early deaths (within 24 h)	11 (32.3%)	15 (31.9%)
Patients with complications	30 (88.2%)	27 (57.4%)
Patients with "liver related" complications	11 (32.3%)	13 (27.0%)

ma severity: usually patients with ISS<25 are addressed to ICU. TC imaging is no routinely part of the follow-up as unnecessary (Cox and coll [45]). On the other hand, angiography and embolization of bleeding vessels or stenting are universally considered a very useful adjuncts to NOM: they allow the control of bleeding in 68% to 87%[16-18], also in difficult-to-access locations [46]. In the Bologna level I Trauma Center, NOM has been considered in patients with the following characteristics: stable hemodynamic parameters [40] (as defined by systolic blood pressure more then 90 mmHg, Base Excess more then 5 mmEq/L, and serum Lactic Acid less then 5 mmEq/L); absence on contrast-enhanced TC scans of abdominal injuries requiring mandatory surgical repair; absence of any clinical sign of peritonitis. 214 (69.5%) of the 308 patients admitted in our Institution from January 2000 to December 2009 met these criterions and therefore were enrolled for the NOM. This was successfully carried out in 185 (86.4%) patients, similarly to what reported in other Institutions [47]. The impressive reduction of laparotomies achived, is up to 60%. Nevertheless, concerns regarding safety of NOM still remain: failure of NOM was registered in 29 patients, which accounts for the 13.6% of the NOM group. Six deaths occurred in the NOM failure group, but it has to be noticed that these are equally distributed among the different AAST liver injury grades (4.1% in I II AAST; 2.0% in III AAST; 2.4% in IV V AAST). In contrast, NOM failure rate becomes bigger in more severely liver-injured patients (25.9% in I II AAST; 19.7% in III AAST; 75.8% in IV V AAST). The different trends of NOM failure and mortality through AAST grades let us suppose that Non-Operative Management failure doesn't involve a bigger mortality and therefore it doesn't affect safe NOM application. NOM safety descends also by the analysis of the results achieved during different times of the study period: mortality passed from the 22.0% registered in the first five years (2000-2004) to the 7.6% registered in the last ones (2005-2009); and this accordingly with a greater rate of success in NOM (53.3% vs 67.5% respectively).

Close examination of NOM failure causes shows the critical points amenable to future improvements. 58.6% of the NOM failures (17 patients) were due to "non-liver

related" causes: for the major part, these were intrabdominal lesions, requiring surgical repair, not detected at first contrast-enhanced TC scan. Low sensitivity of computed tomography in detecting bowel, pancreas, urinary bladder and diaphragm injuries is well known and it's attributable to an intrinsic, technological TC limit. Acute-trauma setting doesn't help because of the pain-related low patient compliance. These findings suggest the need of future TC technological improvements. 41.4% of the NOM failures (12 patients) were "liver-related": except from 1 case requiring laparotomy because of unsuccessful angiographic embolization, in the other 11 cases surgical intervention was performed because of liver-bleeding, causing hemodynamic instability. In 4 patients the bleeding was of venous origin, hardly detectable by contrast-enhanced TC scanning. In 7 patients there was an arterial bleeding, even though negative TC scans. False negative results for contrast pooling at TC, has been reported by Poletti[48] who assessed only a 65% sensitivity in detecting arterial bleeding. We agree with this author that most of these late-onset arterial bleedings despite negative TC scans, can be referred to delayed rupture of traumatic pseudo-aneurysm, to re-bleeding after fibrinolysis of the clot, or to re-bleeding after circulating volume restoration. All this considered, it's reasonable that a follow-up TC performed 36-48 hours later, after trauma, should be able to show lesions, amenable of angiographic embolization, otherwise undiagnosed.

Despite NOM spread, surgical treatment is still necessary: 123 patients, which represent the 40% of the whole population study (308 patients) underwent laparotomy. For 94 patients, this was dictated by haemodynamic instability and evidence of intra-abdominal free fluid at abdominal ultrasonography (FAST), peritonism, or CT findings of hollow or solid organ injury requiring surgical repair. In the remaining 29 patients laparotomy was performed after NOM failure. The analysis of the different surgical options used, demonstrates that in most of the patients with less severe hepatic injury, wasn't required any hemostatic procedure. Liver bleeding often stops spontaneously: this is a well-known observation which have stimulated NOM. When liver bleeding was still going on at laparotomy (as it was in 81 patients), hemostasis was attempted in different ways, according to the presence or not of the "lethal triad" of hypothermia, coagulopathy and acidosis. In this situation Damage Control Surgery is advisable, since it offers the best chances of surviving, not only in case of severe liver trauma, but as well in case in severe pancreatic trauma[42] [43]. In patients affected by this "metabolic failure", perihepatic packing was the treatment of choice. Since 2005, this was performed according to a "new tecnique"[44] which consists of different phases. Firstly, complete mobilization of the right lobe by sharp dissection of the falciform, right triangular and coronary ligament takes place; then a total number of 8 folded laparotomy gauze, coated with topical hemostatic agents, are placed according to a specific topography: around the posterior paracaval space, along the lateral right, the anterior and the posteroinferior visceral surface of the liver. The diaphragmatic surface remains free to avoid unduly elevation and respiratory compromise. Packs are placed around the posterior paracaval space, carefully avoiding any ICV compression. Before 2005, at our Institution there wasn't any standardized packing technique: most frequently, in these earlier years, packing (22 patients) consisted in the placement of a variable number of gauze laparotomy sponges compressing the posteroinferior and anterior surface of the liver over any injured site and elsewhere at the surgeon's discretion. Even though the small size of sample affects statistical significance, a preliminary study comparing the two groups, shows better outcomes with the new techniques [44].

In absence of "lethal triad" a "direct repair" technique was preferred. "Early mortality" which was expected to be worse in patients with the metabolic derangements described, was surprisingly the same of the other group. This seems to prove the efficacy of the packing tecnique in interrupting the "bloody vicious cicle" of hypothermia, coagulopathy and acidosis, therefore avoiding death ("early death" in particular) from uncontrollable bleeding. Obviously, if the better results with the new packing tecniques will be confirmed, as all the patients will be managed in this way, safety and efficacy of packing in case of "metabolic derangements" should become more evident.

Riassunto

INTRODUZIONE: Oggi, la gestione delle lesioni epatiche può variare ampiamente passando da un trattamento completamente nonoperatorio (NOM: non operative management) più o meno adiuvato dal ricorso all'angioembolizzazione delle fonti di sanguinamento fino al trattamento secondo i principi della Damage Control Surgery. Proprio per la complessità del problema e la varietà di opzioni, una gestione multidisciplinare è indispensabile per ottenere il miglior risultato.

MATERIALI E METODI: Durante il periodo 2000-2009, presso il Trauma Center dell'Ospedale Maggiore di Bologna sono stati ricoverati 308 pazienti con lesioni epatiche ed inseriti nel Registro Traumi. Sono stati raccolti i dati demografici e quelli relativi al grado di lesione secondo l'Organ lnjury Scale-AAST, il trattamento iniziale (operatorio o NOM) ed infine l'outcome. Tutti i pazienti sono stati inizialmente valutati secondo i principi dell'ATLS®. In caso di instabilità emodinamica ed evidenza alla FAST eseguita in sala di emergenza di versamento libero, i pazienti sono stati sottoposti ad intervento chirurgico immediato senza ulteriore diagnostica. I pazienti emodinamicamente stabili sono stati sottoposti a TC con mezzo di contrasto e ricoverati per il trattamento nonoperatorio.

RISULTATI: 214 pazienti (69,5%) sono stati inizialmente sottoposti a NOM che ha avuto successo in 195 casi. Per gli altri 29 pazienti, il fallimento del trattamento nonoperatorio è dovuto a cause legate alle lesioni epatiche in 12 casi e in 17 casi a cause diverse. Per i gradi più alti di lesioni meno pazienti sono stati selezionati per il NOM. (85,8% di tutte le lesioni di gradi I-II e 83,3% di quelle di grado III contro il 38,8% di quelle di grado IV e V). Di quelli trattati inizialmente con NOM, il tasso di fallimento è stato maggiore nei casi con lesioni più severe (24,4% di fallimento per cause legate alle lesioni epatiche in quelle di grado IV e V contro l'1,3% e l'1% per quelle di grado I-II e III rispettivamente). 123 pazienti, (40% di tutti i 308 pazienti oggetto dello studio) sono stati sottoposti ad intervento chirurgico: 94 immediatamente dopo l'arrivo in pronto soccorso perchè non selezionabili per il NOM e 29 dopo tentativo di NOM. In 81 casi in cui si osservavano fonti di sanguinamento ancora attive al momento della laparotomia, abbiamo ottenuto l'emostasi con diverse modalità: in quei pazienti che presentavano ipotermia, acidosi e una coagulopatia evidente abbiamo utilizzato il packing peri-epatico come metodica di scelta. Negli altri casi abbiamo preferito ricorrere alla riparazione diretta delle lesioni. La mortalità precoce, che ci aspettavamo essere superiore nei pazienti che presentavano importanti alterazioni metaboliche è stata invece, sorprendentemente, sovrapponibile a quella dell'altro gruppo. Questo a riprova dell'efficacia del packing quando ci troviamo in presenza del "circolo vizioso" indotto da ipotermia, coagulopatia ed acidosi metabolica nel ridurre la mortalità (in particolare quella precoce) da emorragia non controllabile.

CONCLUSIONI: In pazienti emodinamicamente stabili, il NOM delle lesioni dei fegato, con l'utilizzo o meno dell'angioembolizzazione è sicuro ed efficace indipendentemente dal grado della lesioni. Il trattamento secondo i principi della Damage Control Surgey rappresenta il gold standard in caso di instabilità emodinamica.

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