ORIGINAL ARTICLE

Non-operative treatment of 1,768 patients with lesions in the abdominal massive viscerae caused by blunt trauma, tended at the João XXIII Hospital

Tratamento não operatório de 1.768 pacientes portadores de lesões das vísceras maciças abdominais por trauma contuso atendidos no Hospital João XXIII

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ABSTRACT

Objectives: to analyze the results obtained with the implementation of the non-operative treatment protocol (TNO) for blunt abdominal trauma in the João XXIII Hospital (HJXXIII). **Methods:** this was a retrospective study of patients submitted to TNO, victims of blunt abdominal trauma and tended at the HJXXIII, between November of 2004 and December of 2013. **Results:** a total of 1,768 patients met the inclusion criteria. Seventeen patients (0.99%) presented lesions in the three viscerae, 197 (11.1%) in two viscerae, and 1,554 (87.9%) in one viscera. The 1,768 patients had 1,999 lesions distributed as follows: 790 (39.5%) liver lesions, 761 (38%) splenic, and 448 (22.5%) renal. Failure was 4.3% in liver lesions, Grades II and III lesions were the most frequent - 74.2% of the total. In this group of patients the failure index was not over 2%. Failure was more frequent in Grades IV and V lesions occurring in, respectively, 12.5 and 25% of the patients. TNO failure was 7.9% in splenic lesions, Grades II and III lesions were the most common - 75.3% of the patients. TNO failure was greater in splenic lesions grade III (11.3%) and IV (33.3%). Bleeding was the main cause of failure. Failure was 6.6% in renal lesions. Grades II and III lesions were the most frequent (63.3%). TNO failed in 22.8% of patients with grade IV lesion. **Conclusion:** the success of TNO depends on the lesion grade, institutional resources, and an inflexible protocol.

Key words: Liver Injury; Splenic Injury; Kidney Injury; Non-Operative Management; Blunt Trauma; Abdominal Injuries.

RESUMO

Objetivos: *Analisar os resultados obtidos com a implantação do protocolo de tratamento não operatório (TNO) do trauma abdominal contuso no Hospital João XXIII (HJXXIII).* ***Métodos:*** *Estudo retrospectivo em pacientes submetidos ao TNO vítimas de trauma abdominal contuso atendidas no HJXXIII no período de novembro de 2004 a dezembro 2013.* ***Resultados:*** *Durante o período, 1.768 pacientes preencheram os critérios de inclusão. Do total, 17 pacientes (0,99%) apresentavam lesões das três vísceras, 197 (11,1%) de duas vísceras e 1.554 (87,9%) de uma víscera. Os 1.768 pacientes tinham 1.999 lesões assim distribuídas: 790 (39,5%) lesões hepáticas, 761 (38%) esplênicas e 448 (22.5%) renais. Na lesão hepática, a falha foi de 4,3%. As lesões graus II e III foram as mais frequentes - 74,2% do total. Nesse grupo de pacientes o índice de falha não superou 2%. Nas lesões graus IV e V a falha foi mais frequente, ocorrendo em, respectivamente, 12,5 e 25% dos pacientes. Na lesão esplênica a falha de TNO foi de 7,9%. As lesões graus II e III foram as mais comuns - 75,3% do total de pacientes. A falha do TNO foi maior na lesão esplênica grau III (11,3%) e grau IV (33,3%). O sangramento foi a causa principal da falha. Na lesão renal a falha foi de 6,6%. As lesões graus II e III foram as mais frequentes (63,3%). O TNO falhou em 22,8% dos pacientes com lesão grau IV.* ***Conclusão:*** *o sucesso do TNO depende do grau de lesão, recursos institucionais e protocolo inflexível.*

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Palavras-chave: Trauma Hepático; Trauma Esplênico; Trauma Renal; Tratamento não Operatório; Traumatismos Abdominais.

INTRODUCTION

The approach to hepatic, splenic, and kidney lesions caused by blunt traumas has changed significantly from the late 70s to the 20th century. The publication of studies, initially by pediatric surgeons, performed in children with splenic blunt lesions showed that to routinely observe and not operate these patients was feasible and secure.[1] Since then, this non-operative treatment (NOT) was also successfully employed in the treatment of blunt lesions of other abdominal massive viscerae. However, multicenter studies showing success rates greater than 80% were conducted only two decades after the release of the first publications, confirming its safety.[2,3] NOT is currently considered the first choice in the treatment of patients with massive viscera blunt lesions.

There are still many questions to be clarified as well as many questions to be answered about this subject. Guidelines published by the world scientific entities have failed to reach a common denominator in all aspects of this type of approach, even after careful review of the existing literature on the subject.[4,5] Some questions still remain without a consensual definition such as a) what is the time interval in which the hemogram must be carried out?; b) when the patient can return to physical activity and work?; c) is there a need to carry out control imaging exams in all patients regardless of the lesion's grade?; d) in which patients is arteriography effective?. The very definition of NOT failure varies between services that routinely employ the method.

The performance of NOT is not an easy task. It is hard work that requires unmatched perseverance and dedication. The patient may evolve inappropriately at any time during NOT, from the trauma moment until complete lesion healing. A cohesive, competent, and trained staff is needed. A well-written protocol, meticulous patient follow up, and attention on which patient are prone to develop complications is important to understand the lesion's evolution. Knowledge is sedimented, and experience is acquired based on these principles, making the protocol more effective. The NOT protocol must respect certain essential conditions to be implemented (Table 1). The surgical treatment is still the safest option in places where these conditions are not possible to be implemented.

Table 1 - Essential conditions for the non-operative treatment

Well-substantiated Protocol
Specific place to observe and monitor the patient
Coordination of experienced trauma surgeon
Trauma team physical on call
Surgical block, laboratory and imaging exams available 24 hours
Hemodynamic and digestive endoscopy services of easy access

The NOT protocol (Figure 1) was implemented in 2004 in the João XXIII Hospital (HJXXIII) from the State of Minas Gerais Hospital Foundation (FHEMIG), after the creation and organization of an appropriate unit to treat and monitor patients. The sector is specific and called Traumatized Support Room (SAT). A key point to performing NOT is to strictly follow the inclusion criteria outlined in the protocol: a) patients with blunt abdominal trauma who presented hemodynamic stability (systolic blood pressure above 90 mmHg and heart rate less than 110 bpm), or stabilized after initial volemic replacement, at admission; b) absence of signs of peritoneal irritation in the light of the trauma mechanism; c) computed tomography of the abdomen (CT) feasible in the initial evaluation (Table 2).

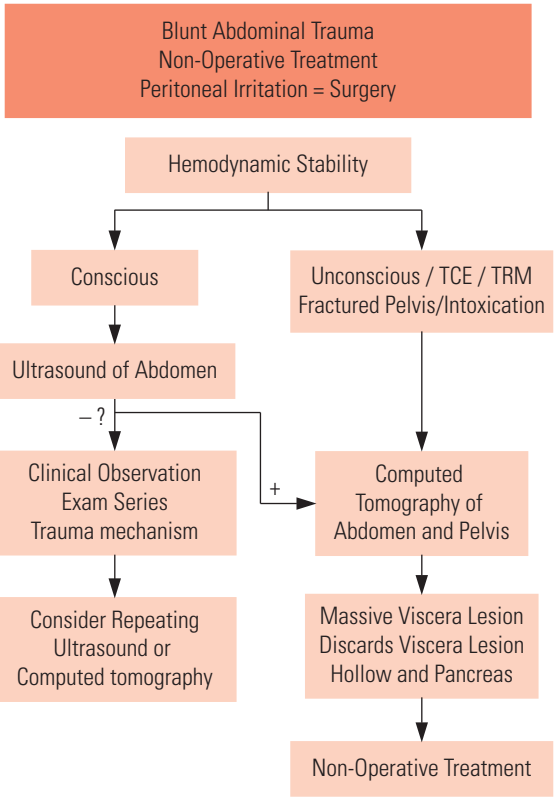

Figure 1 - Algorithm for non-operative treatment of blunt abdominal trauma.

Table 2 - Inclusion criteria

Hemodynamic stability
Absence of signs of peritoneal irritation
Performance of computerized tomography

The use of CT in the evaluation of blunt abdominal trauma since 1981 was undoubtedly the deciding factor for NOT to become the approach of choice for massive viscera blunt lesions.[6] It offers numerous advantages (Table 3). One of the main advantages is the classification of lesions[7] (Tables 4, 5, and 6). The impossibility of performance makes NOT impractical as every imaging method; the CT also has its limitations. The major NOT constraint is that the lesion classification can maximize or minimize its degree by one unit. Therefore, the correlation of findings in the clinical and tomographic examination is essential before starting NOT.

Table 3 - Advantages of CT scan of the abdomen

Verifies which is the injured massive viscera
Establishes the extension and classifies the lesion grade
Quantifies the volume of free fluid
Evaluates the retroperitoneum/ Pancreas lesion
Can diagnose lesion in hollow viscera
Verifies the presence of active bleeding
Follows up the evolution of the lesion healing

Table 4 - Classification of hepatic lesions (AAST)

Grade	Description of the lesion	AIS-90
I	Sub-capsular hematoma, < 10% of surface. Capsule laceration with parenchyma lesion < 1 cm deep	2
II	Sub-capsular hematoma covering 10-50% of surface; hematoma intra-parenchymatous < 10 cm in diameter Capsular laceration 1-3 cm deep and 10 cm in extension	2
III	Sub-capsular hematoma covering > 50% of surface or in expansion; sub-capsular fragmented hematoma or parenchymatous hematoma; hematoma intra-parenchymatous > 10 cm or expansion Laceration > 3 cm deep	3
IV	Parenchyma destruction (laceration) involving 25-75% of the hepatic lobe or 1-3 Couinaud segments	4
V	Parenchyma destruction (laceration) greater than 75% of the hepatic lobe or 3 Couinaud segments over the same lobe Justahepatic venous lesion (cava retrohepatic/vv. Larger central hepatic	5
VI	Hepatic avulsion (vascular lesion)	6

This study aims to analyze the results obtained with the implementation of the NOT protocol in the HJXXIII.

Table 5 - Classificação da lesão hepática (AAST)

Degree	Description of the lesion	AIS-90
I	Sub-capsular hematoma < 10% of surface Laceration of capsule < 1 cm deep	2
II	Sub-capsular hematoma < 10-50% of surface, Intra- parenchymatous hematoma < 5 cm deep Laceration 1-3 cm deep without injuring trabecular vases	2
III	Sub-capsular hematoma > 50% of surface, fragmented or expanding Intra- parenchymatous hematoma > 5 cm or in expansion Laceration > 3 cm deep or injury in trabecular vases	3
IV	Laceration involving segmental or hilar vases producing large devascularization (greater than 25% of the spleen)	4
V	Lesion with complete fragmentation of spleen Vascular lesion of the hilum that devascularizes the organ	5

Table 6 - Classification of the renal lesion (AAST)

Grade	Description of the lesion	AIS-90
I	Microscopic or macroscopic hematuria. Normal studies Sub-capsular non- expansive hematoma. Without parenchyma lesion	2
II	Peri-renal non-expansive hematoma confined to the kidney retroperitoneal space Parenchyma laceration with depth less than 1 cm from the renal cortex without urinary extravasation	2
III	Laceration of parenchyma exceeding 1 cm in depth of the renal cortex without rupture of the excretory system and without urinary extravasation	3
IV	Parenchymatous laceration that extends through the renal cortex, medulla, and collector system Lesion of the main renal artery or vein with contained bleeding	4
V	Completely fragmented kidney Avulsion of the renal hilum that devascularizes the kidney	5

METHODS

This was a retrospective study on patients with abdominal blunt trauma assisted in the HJXXIII in Belo Horizonte, between November of 2004 and December of 2013. All patients were admitted in the polytraumatized patients' room and subjected to initial evaluation according to the ATLS norms. Patients

who fulfilled the inclusion criteria determined by the protocol from the service of general surgery and trauma at the HJXXIII (Table 2) were included in this study. The study was approved by the Ethics Committee under number 049/2009.

The data analyzed were: total number of patients and lesions, concomitant lesions of massive viscerae, global and success rates stratified by the grades of each specific lesion, and morbidity and mortality.

After the initial screening, patients were referred to SAT or Intensive Care Unit (ICU), depending on the severity of their cases, where they were adequately monitored and submitted to a strict and serial clinical examination within short intervals of time. If signs of peritoneal irritation and hemodynamic instability were present or if hematocrit and levels of hemoglobin drops were persistently observed during hospitalization, NOT was discontinued and the patient referred to surgical or another less invasive available treatment, particularly the hemodynamic study by arteriography.

Hospital discharge was granted when the patient was eating properly and showing physiological bowel movement and stabilized hematocrit and hemoglobin. All patients were followed as outpatients until the eighth week after trauma. In this latest evaluation, a control abdomen CT was requested, depending on the lesion's grade, to verify if the massive viscera lesion was already completely scarred. Patients with exams showing lesions fully healed were definitively discharged; other patients remained in control as outpatients until the CT showed definitive lesion healing.

These data were stored in a database built on Excel spreadsheets. Variables were described using measures of central tendency. The Student's t-test was used to test differences between averages. The Pearson Chi-square test was used to verify differences between proportions.

RESULTS

A total of 1,768 patients met the inclusion criteria during the study period. None of these patients presented signs of peritoneal irritation, they were all stable at admission, or were stabilized after the initial volemic replacement and had CT performed. Out of the 1,768 patients, 17 (0.99%) had lesions in three viscerae; 197 (11.1%) had in two viscerae; and 1,554 (87.9%) had in one viscerae. The 1,999 total number of lesions was distributed as follows: 790 (39.5%) liver lesions, 761 (38%) splenic lesions, and 448 (22.5%) kidney lesions (Table 7). There was no NOT failure or death in the17 patients with liver, renal, and splenic lesions. Only one patient, with hepatic lesion grade V and massive hemoperitoneum, was submitted to video laparoscopy for hygiene and drainage of the abdominal cavity.

Table 7 - Non-operative treatment of blunt abdominal trauma. HJXXXIII Nov 04 to Dec 13

Organ	Patients	Failure	Death
Liver	780	34 (4.3%)	43(5.4%)
Spleen	761	60 (7.9%)	26 (3.4%)
Kidney	448	30 (6.6%)	11 (2.4%)

The 197 patients with two lesions comprised 82 (41.6%) hepatic and renal lesions; 72 (36.6%) splenic and renal lesions; and 43 (21.8%) splenic and hepatic lesions. The kidney was the organ most commonly involved in lesions associated with another massive viscera (78.2%). The success and mortality rates in patients with two lesions are listed in Table 8. Three NOT failures were observed in the group with hepatic and splenic lesions: two due to splenic lesions and one due to a liver lesion. In the group with liver and renal lesions, NOT failures were due to right diaphragmatic lesion; complication occurred in the patient with hepatic lesion grade IV, requiring video laparoscopy for aspiration in voluminous hemoperitoneum and abdominal cavity drainage. Finally, three failures occurred in the group with splenic and renal lesions, two due to splenic lesions and one due to a duodenal lesion, which was operated 10 hours after the trauma. The splenic lesion was the main cause of NOT failure when it was associated with kidney or liver lesions.

Table 8 - Failure. complications. and death indices in patients with lesions in multiple massive viscerae in patients undergoing NOT. HJXXXIII Nov 04 to Dec 13

Injured organs	No. patients	NOT Failure	Death
Liver + Spleen + Kidney	17	1 (5.9%)	–
Liver + Spleen	43	3 (7%)	–
Liver + Kidney	82	2 (2.4%)	–
Spleen + Kidney	72	3 (4.1%)	–

During the study period, 87% of patients with blunt hepatic lesion admitted to the HJXXIII fulfilled the NOT protocol criteria, totaling 790 cases. Among these, 648 presented the liver as the only site of ab-

dominal lesion (82%). The overall failure rate in all patients with blunt hepatic lesions submitted to NOT was 4.3% (Table 7). The most frequent lesion grades were II and III corresponding to 74.2% of the total. However, the index of failure was not over 2% in this group of patients (Table 9). NOT failure was more frequent in the most serious lesion grades, IV (17.1%) and V (0.6%), occurring in 12.5 and 25% of patients, respectively. Among the 34 patients who showed NOT failure, 14 (41.1%) evolved to death; however, in two of them, death was not directly related to NOT failure but related to the associated ECA. All patients where death was caused by NOT failure in liver lesions showed lesions grade IV or V. The NOT complications that required surgical or minimally invasive treatment are listed in Table 10. TCE (46.5%) was the main cause of death in 43 patients.

Table 9 - Non-operative treatment of blunt hepatic trauma. Classification of lesions by grade and their relation with NOT failure. HJXXXIII Nov 04 to Dec 13

Lesion Grade	Percentage	NOT failure
I	8.1%	1.6%
II	35.9%	1.8%
III	38.3%	2.0%
IV	17.1%	12.5%
V	0.6%	25%

Table 10 - Complications of NOT for blunt hepatic lesion treated with surgery. HJXXXIII Nov 04 to Dec 13

Type	Patients
Related to hepatic lesion	
Intra-abdominal hypertension	6
Hemobilia	2
Infected hematoma	1
Bileoma	2
Unnoticed lesions	
Extra-hepatic biliary pathway	3
Right diaphragm	2
Small intestine	1

A total of 71% of the patients who presented splenic lesion as the reason for assistance during the study period were referred to NOT. Splenic lesions were observed in 761 patients; in 629 among these the only lesion was in the spleen (82.6%). NOT failure happened in 60 patients (7.9%) (Table 7). The most common lesions were those of grades II and III, corresponding to the percentage of 75.3% of all patients. However, unlike liver lesions, the NOT failure rate in splenic lesions grade III (11.3%) was well above that in lesions grade II (1.2%) (Table 11). In splenic lesions grade IV, NOT failure was observed in one-third of all patients. NOT was conducted in only one patient with grade V lesion (0.1%), who was a three years old child. Bleeding was the main cause of NOT failure in splenic lesions. It was present in 51 patients, accounting for 85% of all patients with NOT failure (Table 12). The main clinical presentations of this bleeding were: patients who arrived unstable but were stabilized with the initial volemic replacement and became unstable again; progressive hemoglobin drop without significant hemodynamic instability; and acute bleeding with important hemodynamic repercussion. Among those 26 patients who were submitted to NOT for splenic lesions and died, NOT failure was the cause of death in only one.

Table 11 - Non-operative treatment of blunt splenic trauma. Classification of lesions by grade and their relation with NOT failure. HJXXXIII Nov 04 to Dec 13

Lesion grade	Percentage	NOT failure
I	15.1%	1.8%
II	33%	1.2%
III	43.3%	11.3%
IV	8.4%	33.3%
V	0.1%	0%

Table 12 - NOT failure in blunt splenic lesion. HJXXXIII Nov 04 to Dec 13

Cause	Number of patients	Percentage
Bleeding	51	85%
Abdominal Pain	05	8.3%
Unnoticed lesion	03	5%
Intra-abdominal hypertension	01	1.7%
Total	60	100%

In 87.6% of patients with blunt renal lesions, NOT was the initial option. Among a total of 448 patients, 277 showed the only abdominal lesion in the kidney (61.8%). The NOT failure index was 6.6% (Table 7). As in other lesions in massive viscerae, lesions grades II and III were the most frequent (63.3%). NOT failed in 22.8% of patients with renal lesion grade IV (Table 13). Bleeding was the main cause of NOT failure and involved 24 patients (80%); the kidney was pathogenic in three of these patients (Table 14).

Table 13 - Non-operative treatment of blunt renal trauma. Classification of lesions by grade and their relation with NOT failure. HJXXXIII Nov 04 to Dec 13

Lesion grade	Percentage	NOT failure
I	18%	1.2%
II	35%	1.9%
III	28.3%	5.6%
IV	15.2%	22.8%
V	3.4%	14%

Table 14 - NOT failure of blunt renal lesion. HJXXIII Nov 04 to Dec 13

Cause	Number of patients	Percentage
Sangramento	24	80%
Urinoma	03	10%
Lesão Despercebida	02	6.7%
Dor Abdominal	01	3.3%
Total	30	100%

DISCUSSION

Over the past three decades, the use of NOT for blunt lesions in massive viscerae revolutionized the approach to poly-traumatized patients. Its use has been progressively and gradually increasing due to growing experience and confidence acquired with its use, and the exponential development of the technology of imaging methods and minimally invasive therapy. Various trauma reference services raised the percentage of its use over the years, ranging from 0% in the 70s to 65% in the 90s.[8,9] However, because there is no standardization between studies conducted on this theme, the comparison between them is difficult because, for example, there is no consensus on the time for NOT initiation and what is its failure concept. In addition, few are the studies that spontaneously stratify the incidence of failures and complications relative to the lesion grade. Moreover, there is no uniformity or consistency between the analyzed data in studies based on databases.

Currently, NOT for massive abdominal viscerae lesion caused by blunt trauma is the method of choice in hemodynamically stable patients. The careful selection of patients is undoubtedly the key to success in this type of approach. The advantages of NOT include decreased hospital costs, early discharge, reduced number of non-therapeutic laparotomies, decreased need for blood products, and reduced morbidity. Publication using the American National Trauma Data Bank, such as this study, indicate that the vast majority of lesions of massive abdominal viscerae by blunt trauma is treated without surgery.[10] Several studies also show that the lesion severity (classified by CT or by the hemoperitoneum volume), associated TCE, age over 55 years, and/or intra or extra-abdominal associated lesions are not absolute contraindications to perform NOT in hemodynamically stable patients.[11-13] In this study, the existence of two or three massive viscerae concurrently affected, regardless of which of them, did not increase mortality and presented NOT failure indexes of 7% or less (Table 8). The concept of NOT failure or complications overlap in most publications, however, it is observed that they occur when there is a need for some kind of invasive intervention during treatment. Those that are common in liver, kidney, and splenic lesions are: a) bleeding requiring control through angiography with embolization or surgery; b) unnoticed lesions in hollow viscerae or any intra-abdominal viscera requiring surgery for correction.

In the present study, NOT was employed in the vast majority of patients with blunt hepatic lesions (87%) showing the lowest failure rate among the three evaluated viscerae (4.3%). This finding can be explained by liver bleeding, for the most part originated in veins and due to low pressure. Most patients had lesions at grades from I to III (82.3%) and failure indices between 1.6 and 2% (Table 9). The complex defined hepatic lesions, most often as grades III to V, can be approached by NOT and present less morbidity and mortality than those surgically treated.[14] Nevertheless, a large number of studies, including this one, demonstrate that grade III lesions behave as grades I and II in relation to the percentage of failure and morbidity from NOT.[15,16]

Carillo et al. obtained similar results, with 5% failure rates in grade III lesions; 51% in grade IV; and 71% in grade V.[17] Kozar et al. also conducted a multicenter study analyzing 453 patients submitted to NOT. In 61 of these (13%), NOT failed with failure indices of 5% in grade III lesions, 22% in grade IV, and 52% in grade V.[18] These publications also reveal more proximity of grade III lesion with lesions grades I and II. Complications related to liver lesions per se and NOT failure are also more frequent in grades IV and V lesions, however, no statistically significant evidence that the lesion grade is a predictive factor of NOT failure for blunt hepatic lesions was observed.[18,19] Hemodynamic stability is still the most important criterion in the selection of treatment for blunt hepatic lesions.[20]

The main cause of NOT failure was bleeding. The early use of angiography is well indicated when there is contrast extravasation in the arterial phase of CT. Its use in grades IV and V lesions to diagnosis and treatment of a probable arterial lesion is still controversial. The possibility of increasing NOT success with this approach is described by some authors.[21-22]

In addition to the common causes of splenic and renal lesions (bleeding and unnoticed lesion), hepatic lesions present inherent complications that can lead to NOT failure. The increase in intra-abdominal pressure was the most frequent complication in hepatic lesions per se, mostly due to hemoperitoneum associated with choli peritoneumin patients with grade IV or higher grade lesions and voluminous hemoperitoneum in the CT (Table 10). It is consequent to a biliary peritonitis associated with an exacerbated inflammatory response (SIRS). The clinical manifestations are more evident after the third day of trauma. The early diagnosis is essential to an effective treatment. The daily thorough clinical examination and intra-vesical pressure monitoring are important. Bloating and abdominal pain, dehydration, tachycardia, and tachypnea with or without jaundice should be valued. The abdominal ultrasound revealing large amounts of free fluid confirms the diagnosis. Treatment options vary depending on the clinical condition of the patient and institution resources. Videolaparoscopy for hygiene, washing, and drainage of the abdominal cavity is the most appropriate and least invasive treatment.[17,23] When used, it is advisable to perform paracentesis prior to pneumoperitoneum in order to decompress the abdominal cavity and decrease the intra-abdominal pressure.

In the blunt splenic lesion, the option of NOT was possible in 71% of the patients, being less frequent when compared with cases of liver and kidney lesions; however, the failure index was higher (7.9%). These data can be partially explained by recalling that the spleen does not have anatomical structures to buffer arterial bleeding. Splenic lesions grades I and II are considered simple and occurred in 48.1% of patients. The success rate in both was higher than 98%, and NOT failure, when it occurred, was not due to bleeding. Serious injuries are from grades III to V and compromised 51.7% of patients, the vast majority being of grade III (Table 11). However, they have a different behavior. Although the bleeding is the leading cause of NOT failure in grades III and IV lesions, its incidence was three times higher in grade IV lesions (Table 11). This fact was decisive for a change in protocol. Due to this high percentage of failure, the surgical treatment in these patients was chosen, especially if they were admitted with hemodynamic instability, even if responsive to volemic replacement.[24] The protocol was updated again since 2013 when it was possible to perform routine arteriography in the service. Currently, arteriography and, if necessary, embolization of the injured vessel are performed before starting NOT in cases of grade IV lesions. Several studies have demonstrated that this option increases the success rate of NOT.[25] In cases of grade III lesions, however, arteriography is only indicated if any extravasation of contrasting fluid is observed (blush), although some services also use it in lesions of this grade even without fluid extravasation.

There is a technical discussion about the site of embolization of in the splenic artery, proximal or distal.[26] There is still no consensus, and the technique must be customized for each patient. The arteriography is not a risk-free treatment. It can fail in 15% of cases, and the incidence of complications oscillates around 20%.[27,28]

Grade V lesions are indicated for surgical treatment when properly classified because only in exceptional cases of total spleen fragmentation the patient presents hemodynamic stability.[29] It is an exception conduct in children under ten years old and must be performed with caution and only in hospitals with all available resources. It should be recalled that, such as in liver lesions, the primordial condition for NOT is the hemodynamic stability and not the lesion grade.

The splenic bleeding usually happens in two peaks: early (between 24 and 72 hours after the trauma) and late (between the seventh and ninth days after trauma). All patients who have bled had lesions grades III and IV. Patients admitted with hemodynamic instability and who were stabilized after the volemic replacement had a higher incidence of bleeding. The late bleeding is more common in grade III lesions that present extensive spleen sub-capsular hematoma. These patients, when indicated to NOT, must be closely followed-up and have CT performed prior to hospital discharge to study the evolution of the lesion. There have been cases of hematoma rupture on the 17th day after trauma in the experience of this service. Therefore, the current protocol conduct is to achieve surgical treatment in these patients prior to discharge. However, this is not a consensual proposal because there is great variation in opinions on the cause and treatment of delayed bleeding in blunt splenic le-

sions.[30] Some authors recommend disclosing to the patient with this type of lesion about the possibility of late bleeding; however, this is not an idea that must be propagated due to its serious consequences.[5,31]

Unnoticed injuries were the cause of NOT failure in three patients, all with lesions grades I and II. Two of them had small bowel lesions (0.26%) confirming the low frequency of this lesion reported in a multicenter study (0.3%).[32] The risk of unnoticed lesions should not influence the option for NOT. The patient with isolated blunt splenic lesion and selected for NOT cannot die due to a splenic lesion complication because the mortality from surgical treatment of splenic trauma in stable patients is practically negligible.

NOT for blunt renal lesions was already proposed and experimentally used since the 50s. With the advent and use of CT in trauma, due to a more detailed diagnosis of minor lesions, its incidence has increased and shown that most renal lesions that are treated this way fully heal without sequelae. NOT was employed in this study in 87.6% of patients with blunt renal lesions, with an index a little higher than that of liver lesions but with incidence of failure (6.6%) just a little below that of splenic lesions (Table 7).

The kidney was, also, the viscera with the lowest incidence (61.8%) of isolated lesions among the other massive viscerae. Less serious lesions (grades I-III) were also more frequent (81.4%), with failure rate lower than 6% (Table 13). Grade IV lesions, for being more serious and affecting the excretory and collector systems, showed the highest failure index (22.8%). Although the fascia of Gerota acts as an effective mechanism to buffer and contain bleeding of renal origin, it was the main cause of NOT failure (Table 14).

Arteriography with embolization of the injured vessel was the treatment used in three patients. Conventional surgery was the option for the remaining patients. The indications for embolization in renal trauma are: extravasation of contrasting fluid (blush) in the CT and persistent fall in hemoglobin and macroscopic hematuria for more than five days. There is still controversy if in renal lesion grade IV NOT is safe when great contrasting fluid extravasation is observed in the excretory system. NOT is feasible if the extravasation is through the caliceal system or the renal pelvis with the contrasted ipsilateral ureter. The insertion of a stent (double J) is recommended in cases with large contrasting fluid extravasation. Some authors, however, find the use of the double J stent arguable.[33] Conversely, if there is contrasting fluid extravasation in the renal pelvis and the ipsilateral ureter is not contrasted, the diagnosis is ureteropelvic disjunction and surgery is the best option.

CONCLUSIONS

The use of NOT in massive abdominal viscerae lesions caused by blunt trauma showed that each organ has particular characteristics and behaviors. One should not treat patients with lesions in different organs with the same conduct. A specific protocol is necessary for each organ in particular.

The compliance with the essential requirements and criteria for inclusion in the protocol is strictly necessary in order to obtain good results in this type of approach. NOT for blunt abdominal trauma is only safe in these circumstances. When this standard cannot be met, the best option is the surgical treatment.

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