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Gastrointestinal and mesenteric injuries in the trauma patient: incidence, diagnosis delay, and prognosis☆

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A B S T R A C T

Background: Gastrointestinal and mesenteric injuries (GIMI) are uncommon in trauma patients, and their diagnosis are often delayed. Our aims were to determine the reliability of CT scan in our centre, and to assess the clinical significance of a delayed diagnosis.
Materials and method: Retrospective analysis of cases confirmed at laparotomy. Patients were identified at the Severe Trauma Registry of Hospital General Universitario Gregorio Marañón, between 1993 and 2006.
Results: We found 105 (16.6%) GIMI out of 632 patients with abdominal trauma, in a Registry with 1495 severe trauma cases included. A total of 46% had blunt injuries. The mean injury severity score (ISS) and new ISS (NISS) were 20 and 25, respectively. There were 9 (8.5%) deaths, 4 of which were unexpected. A CT scan was performed in 56 (53%) cases, and only in 37 there were signs suggestive of a GIMI. In another 43 (41%) patients an urgent laparotomy was indicated because of positive clinical findings or instability. Surgery was delayed for more than 8 h in 21 (20%) patients, the most common reason being a false negative result in the CT scan.
Conclusions: The overall incidence of GIMI was high in our centre (31% due to penetration and 10.7% blunt trauma). Several factors, such as the initial lack of symptoms, a low diagnostic sensitivity of the CT scan (34% false negatives), and the non-surgical management of solid organ injuries, have contributed to a delayed diagnosis and treatment in 1 out of each 5 patients in our series, but this has not led to a significant increase in septic complications in this group

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Lesiones gastrointestinales y mesentéricas en el paciente politraumatizado: incidencia, demora diagnóstica y pronóstico

Palabras clave:
Traumatismo abdominal
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RESUMEN

Introducción: Las lesiones gastrointestinales y mesentéricas (LGIM) son poco frecuentes en el traumatizado, y su diagnóstico es, en ocasiones, tardío. Nuestros objetivos han sido determinar la fiabilidad diagnóstica inicial de la tomografía computarizada (TC) en nuestro centro, así como la posible repercusión clínica de la demora diagnóstica en estas lesiones.
Material y método: Estudio retrospectivo de los pacientes con LGIM recogidos en nuestro Registro de Trauma Grave entre 1993 y 2006.
Resultados: De los 1.495 traumatizados registrados, 632 tenían traumatismo abdominal y 105 (16,6%) presentaron LGIM, en un 46% secundarias a un traumatismo cerrado. El ISS y el NISS medios fueron 20 y 25, respectivamente. La mortalidad fue de 9 (8,5%) pacientes, 4 contra pronóstico. En 56 (53%) casos se realizó una TC, y se observaron signos de LGIM en sólo 37. En otros 43 (41%) pacientes se indicó una laparotomía urgente por inestabilidad o signos clínicos de lesión intraabdominal. En 21 (20%) casos la cirugía se demoró más de 8 h, y la causa más frecuente fue un falso negativo en la TC.
Conclusiones: La incidencia total de LGIM ha sido alta en nuestro medio (el 31% en traumatismo abdominal penetrante y el 10,7% en cerrado). Diversos factores como la ausencia inicial de clínica, la baja sensibilidad diagnóstica de la TC (un 34% de falsos negativos) y el manejo conservador de las lesiones de órgano sólido han llevado a diagnóstico y tratamiento tardíos en 1 de cada 5 pacientes de nuestra serie, sin que ello haya implicado un aumento significativo de la morbilidad infecciosa.

Introduction

Gastrointestinal and mesenteric injuries (GIMI) are uncommon in trauma patients, but the potential associated morbidity and mortality make it necessary to confirm their absence when faced with a penetrating or high-energy blunt abdominal traumatisms.

There is a great amount of controversy regarding the clinical repercussions of the delayed diagnosis of GIMI; therefore, various authors have highlighted the importance of a fast diagnosis and treatment,[1-3] while others have not found any relationship between delayed diagnosis and greater morbidity and mortality.[4-7]

The early diagnosis of the GIMI continues to be a challenge for emergency surgeons, especially in blunt traumatisms. They are initially asymptomatic lesions in many cases, where the neurological state of the patient can make any correct exploration difficult; on the other hand, various publications have questioned the diagnostic sensitivity of imaging techniques, with high rates of false negatives with the computed tomography (CT).[8] These factors, together with the current trend to handle hepatic and spleen injuries conservatively, cause the GIMI to be, together with diafragmatic injuries, the most unnoticed injuries in abdominal traumatisms.

The objectives of our study are to determine the incidence and the characteristics of this type of injuries in our environment, to analyse the sequence and the delayed therapeutic diagnosis, paying special attention to the reliability of the CT, and to evaluate the possible repercussions of these delays in the postoperatory infectious complications.

Patients and method

This is an observational and retrospective study of patients with GIMI, confirmed by laparotomy, admitted to the Hospital General Universitario Gregory Marañón between 1993 and 2006. The cases were identified from the Registry of Severe Trauma in our centre, whose inclusion criteria have previously been published.[9]

We analyse the demographic and clinical characteristics, the mechanism of injury, associated lesions, diagnosis-therapy scheme, unexpected mortality according to the TRISS[10] methodology and the morbidity and mortality associated with the delayed diagnosis. We have established a delayed diagnosis as being 8 h after arrival to our centre, following a recent multicentre study,[8] time in which, theoretically, the peritoneal cavity has been contaminated.

We have only considered type II-V injuries from the Organ Injury Scaling System[11,12] as significant injuries: perforation, sectioning or bursting of hollow organs, mesenteric lesions with contrast extravasation, and/or that compromise intestinal viability (Figure 1).

The CT was performed with intravenous contrast; the spiral technology was introduced in our centre in the year 2000, and the multichannel CT in the year 2006. According to the existing bibliography,[13-16] we determine findings from the CT as compatible with GIMI as pneumoperitoneum or retropneumoperitoneum; rupture or thinning of the intestinal wall; haematoma or infiltration of mesenteric fat; the extravasation of vascular contrast in surrounding areas, or an abundant or moderate quantity of free liquid without evidence of solid organ lesions. The results analysed in the

CT correspond to those emitted by the radiologist on duty. The statistical study has been carried out using SPSS 14.0 for Windows (SPSS, Inc., Chicago, Illinois, United States). Values of $P \leq .05$ are considered as significant.

Results

Between 1993 and 2006, a total of 1495 patients were admitted to our hospital due to severe traumatisms, of which 632 suffered from abdominal traumatism (448 blunt and 184 penetrating), and where 105 (16.6%) of them demonstrated a significant GIMI. The demographic characteristics and the severity of the injuries is summarised in Table 1.

Table 2 reflects the injuries found, the initial diagnosis-therapy approach, the delay from admission to surgery and the unexpected mortality. The most frequent associated abdominal injury was the hepatic injury, present in 12 (11%) cases. Among the non-abdominal associated injuries, the most common were the thoracic ones (31%). It must be pointed out that in 7 cases of blunt traumas (14%), the GIMI was associated to lumbar vertebra fractures.

Figure 1 – Mesenteric tear from blunt abdominal traumatism.

Only 46% of the patients with blunt traumas presented clinical signs upon their arrival that showed signs of intraabdominal inuries, compared with 82% in the penetrating trauma series.

When analysing the diagnosis-therapy scheme (Figure 2), we observed that 43 urgent laparotomies were performed, without previous CT or diagnostic peritoneal lavage (DPL). Six DPLs were performed where only 1 was negative and, when repeated hours later, was positive for intestinal content. A CT was performed in 56 patients; in 19 (34%)—14 for blunt trauma—no signs of GIMI were observed. We compared the results of the CT before and after introducing the spiral technology in our centre, but no significant differences were found concerning sensitivity (60% compared to 78%; $P=.3$). We registered 21 (20%) cases with surgical delay, where the most frequent cause was a false negative in the CT findings. We did not identify differences regarding the diagnostic time between patients with isolated GIMI and those that had other concomitant intraabdominal injuries.

We carried out 6 "damage controlling" surgeries; 2 of these patients passed away before we were able to close the laparoscopy. In 4 injuries by sharp weapons (ISW), surgery was initiated using laparoscopy that had to be converted into open surgery in 1 case.

Nine (8.6%) patients passed away, 5 from causes clearly related with the GIMI. Of the deaths, 4 (44%) had a prognosis to survive according to the TRISS methodology (Table 2). One of them presented perforation of the transversal colon, stomach, duodenum and the gall bladder by a sharp weapon, the patient suffered dehiscence of the colic sutures and died from MOF. Another 2 patients died from blunt trauma with injuries of the solid organs treated in a conservative manner

Table 1 – Demographic characteristics and injury severity

	Penetrating (n=57)	Blunt (n=48)	Entire series (n=105)
Age, y	32 [25–40]	37 [25–51]	33 [25–45]
Males	55 (96)	36 (75)	91 (87)
Females	2 (4)	12 (25)	14 (13)
Mechanism of injury			
SWI	38 (67)	–	38 (36)
FAI	19 (33)	–	19 (18)
Car accident	–	22 (46)	22 (21)
Motorcycle accident	–	11 (23)	11 (10)
Runover	–	5 (10)	5 (5)
Fall	–	3 (6)	3 (3)
Others	–	7 (15)	7 (7)
Injury severity			
RTS	11.7 (0.9)	10.2 (3.3)	11 (2.4)
ISS,	16 (7)	24.5 (13.5)	20 (11)
NISS	23 (11	27 (15)	25 (13)
Shock	4)	11	15 (14)

The values express n (%), median [interquartile interval], or mean (standard deviation).
FAI indicates firearm injury; ISS, Injury Severity Score; NISS, New Injury Severity Score; RTS, Revised Trauma Score; SWI, sharp weapon injury.

Table 2 – Injuries found, initial attitude, delay time, and unexpected mortality

	PenT (n=57)	BluntT (n=48)	Entire series (n=105)
Stomach	7	0	7
Isolated injury	0	0	0
Small intestine	42	30	72
Isolated injury	21	20	31 (43)
Large intestine	24	11	35
Isolated injury	5	2	7 (20)
Isolated mesenteric injury[a]	1	11	12
Isolated meso-colon injury[a]	0	5	5
Injury >1 hollow organ	13	3	16
Injury >2 hollow organ	3	0	3
Associated abdom. injuries	27	16	43
Extraabdominal injuries	14	35	49
Urgent laparotomy	40	3	43 (41)
SWI	21	–	–
FAI	13	–	–
Shock	6	3	9
DPL	1	5	6
CT	16	40	56 (53)
(False negatives)	5	14	19 (34)
Delay >8 h	5 (8.7)	16 (33)	21
Delay, min	38 [18–100]	127 [75–592]	
Mortality	3 (5)	6 (12.5)	9 (8.5)
Mortality with Ps>50%	2	2	4
TRISS	98%, ISS 16 92%, ISS 21	85%, ISS 21 90%, ISS 43	

The values express n (%), median [interquartile interval].
BluntT indicates blunt traumatism; CT, computed tomography; FAI, firearm injury; ISS, Injury Severity Score; DPL, diagnostic peritoneal lavage; PenT, penetrating traumatism; Ps, Probability of survival according to the TRISS model; SWI, sharp weapon injury; TRISS, Trauma Revised and Injury Severity Score.
[a]Injury without perforation of hollow organ, but that requires haemostasia and/or resection by devascularisation.

after producing a false negative in the CT findings. The other deaths were from concomitant injuries, mostly, severe craneocephallic traumatisms.

The median (interquartile interval) hospital stay was 12 (5-23) days, and 46 (44%) cases needed to be admitted to the reanimation unit, with an average of 4 (2-9) days. Forty (38%) suffered postoperatory complications (Table 3), and the most frequent complication was the infection of the surgery wound. 49% of the patients operated on 8 h after the injury took place presented septic complications, compared with 27% of those operated on in the first 8 h (Table 4). However, given the small sample size, there are no statistically significant differences (P=.13).

Discussion

GIMIs are rare in blunt traumatisms, with an incidence lower than 1%.[13,17] However, in our series, we found a 10.7% incidence, a difference that can be explained due to the inclusion bias in our registry, that only includes patients with a certain level of severity, and because only significant injuries were included in our study.

In spite of the low total incidence, the morbidity and mortality associated with this type of injuries can be high. Thus, in the multicentre study carried out by the Eastern Association for the Surgery of Trauma (EAST),[7] on blunt GIMI, the mortality associated with intestinal and colorrectal injuries was 15% and 19.4%, respectively. Our mortality in blunt GIMI is lower (12.5%), and 5% for penetrating traumatisms.

According to certain authors, this morbidity and mortality are directly related with the delay of the therapeutic diagnosis.[1,2] Fahkry et al[2] analysed 198 cases of blunt traumatic intestinal injuries from the EAST multicentre study and, of the 21 cases of mortality related with intestinal injuries, 43% were attributed to surgical delay, and they demonstrated a progressive increase in mortality depending on the time that passed between when injury was produced and surgical treatment. Of the 5 deaths related with GIMI of our series, 2 (40%) were attributed to surgical delay.

Various groups have questioned this relationship between the delay and morbidity and mortality and they find no significant differences.[4-7] Others have not found significant differences in mortality if the surgery is done in the first 24 h.[18] We also did not find significant differences in the morbidity and mortality in our series associated with a surgical delay greater than 8 h, although the number of patients in our study is small. In any case, one of the causes of this discrepancy in the bibliography has been the tendency to group major and

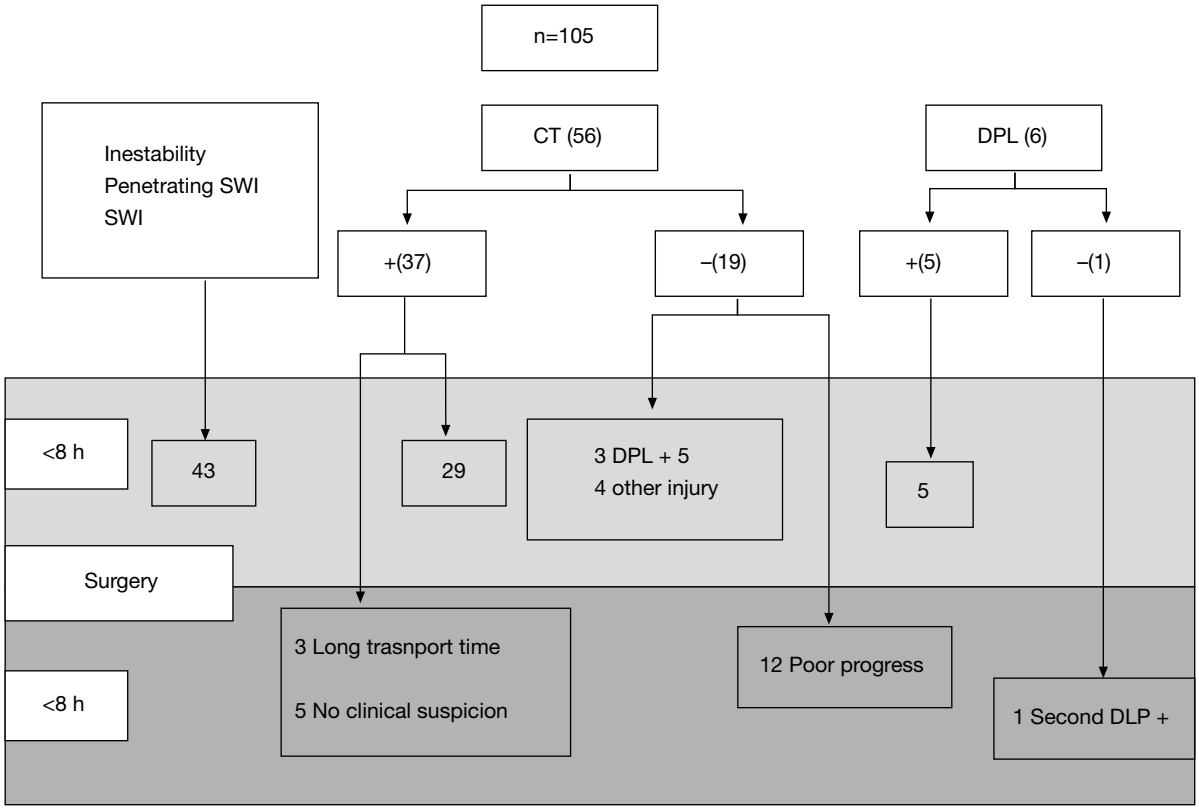

Figure 2 – Diagnostic sequence.

Table 3 – Total morbidity

	Patients, No. (%)
Total	105
Infection of surgical wound	19 (18)
Respiratory complications	13 (11.4)
Intraabdominal abscess	6 (5.6)
Postsurgical bleeding	5 (4.7)
Septic shock/multi-organ failure	5 (4.7)
Evisceration	4 (3.8)
Dehiscence of anastomosis	2 (1.9)
Intestinal obstruction	2 (1.9)
Pancreatitis	2 (1.9)
Urethral fistula	1 (0.9)

minor complications and include complications that are not directly related with GIMI.[19]

To be more precise, we must distinguish between delay and mortality in patients with isolated GIMI or with multiple associated injuries. In the EAST study,[17] the patients with multiple injuries operated on before 24 h had greater mortality than those operated on afterwards, although this difference was not significant; however, the patients with isolated GIMI operated on before 24 h had a significantly lower rate of mortality than those operated on after this amount of time. This is explained, without doubt, by the greater total severity of the patient with multiple injuries that should be operated on as early as possible.

Colon injuries constitute a special subgroup, as about 90% are secondary to penetrating traumatisms,[19] 69% in our series. The extensive review of Ross et al[20] did not show any relationship between delay and morbidity in these patients.

The early clinical diagnosis of GIMI in poly-traumatised patients is difficult, due to the frequent initial absence of peritoneal signs. In our series, only 46% of the GIMI from blunt traumatisms presented signs of peritonism when they arrived, a rate similar to the 40% of the series of 74 cases done by Hughes et al.[1] The frequent association of this type of injuries to a decrease in the level of consciousness partly explains this fact, and makes it necessary to systematically carry out diagnostic tests. However, the sensitivity that the imaging techniques offer does not allow for the safe disregarding of a GIMI in a poly-traumatised patient. Thus, the diagnostic sensitivity of the CT oscillates between 69% and 97%, with a specificity of 78%-99%.[8,13-16,21-23] These rates belong to a series studied with a retrospective character by specialised radiologist, which could explain the difference with the 34% of false negatives found in our series, which corresponds with the first evaluation of the images by the radiologist on call. Due to the long study period, there are different generations of CT technology present in our series. The diagnostic sensitivity of this imaging technique was greater after the year 2000 (78%), when the majority of the CT

Table 4 – Related morbidity, depending on the diagnostic delay and the mechanism of injury

	<8 h (n=84)			<8 h (n=21)		
	Blunt (n=32)	Penetrating (n=52)	Total, No. (%)	Blunt (n=16)	Penetrating (n=5)	Total, No. (%)
Wound infection	6	8	14 (16.6)	2	3	5 (24)
Intraabdominal abscess	0	4	4 (4.7)	0	2	2 (9.5)
Septic shock/MOF	2	2	4 (4.7)	1	0	1 (4.7)
Dehiscence of anastomosis	0	1	1 (1.2)	1	0	1 (4.7)
Total	8	15	23 (27)	4	5	9 (43)

Without statistically significant differences.

were performed with spiral technology, although due to the reduced sample size, we have not been able to demonstrate significant differences between the different periods.

The reliability of the CT becomes more interesting in the context of the conservative treatment of solid organ injuries. Miller et al[24] published in 2002 an incidence of intestinal injuries of 11% in patients with blunt abdominal traumatisms and hepatic lesions that were candidated for non-surgical initial treatment, and 2.3% of these intestinal injuries went unnoticed.

In spite of this data, the low incidence of hidden intestinal injuries in blunt abdominal traumatisms does not justify the explorative laparotomy. Kemmeter et al[25] did not find significant differences between patients with isolated intestinal injuries and those with concomitant injuries of solid organs regarding the time passed until the diagnosis was made and the enteric injury was repaired.

In penetrating abdominal traumatisms, the GIMI are commonly associated with a pathological physical examination (82% of our series). When there are doubts about cavity penetration, it is more and more common to use imaging technique; however, non-therapeutic laparoscopies in these cases represent 11%-40%, with an associated morbidity of 5%-22%.[26,27] In this context, the diagnostic laparoscopy has demonstrated very good results in some series,[28,29] however, the laparoscopy does not have a good sensitivity to detect intestinal injuries; in this line, Krausz et al[30] have recently proposed the realisation of a DPL in cases where the laparoscopic exploration is negative.

From our analysis, we can conclude that the early diagnosis of these injuries continues to be a challenge, with a considerable percentage of diagnostic delays that, nonetheless, do not seem to significantly affect morbidity and mortality.

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