[J Tokyo Wom Med Coil
67 (9・10) 815～820 (1997)]

JUDGE OF SURGICAL INDICATION FOR BLUNT INJURIES OF LIVER AND SPLEEN BY CT IMAGING

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(Received May 15, 1997)

Recent studies have elucidated that the findings of injuries of parenchimatous organs such as liver and spleen by computed tomography (CT) are consistent with those by surgical operation. But it is still unclear whether CT findings can determine operative indication for blunt injuries of liver and spleen. We performed a retrospective study on 35 lesions of blunt injuries of liver and spleen in 33 cases for blunt injuries of liver and spleen at our hospitals to examine whether CT findings can determine the severity of damage and surgical indication for the injuries, and the following results were obtained.

1. Based on CT findings, the presence of injury was confirmed in all cases except for one lesion.

2. Comparison of CT findings and operative or laparoscopic findings in 12 cases undergoing operation or laparoscopy for liver/spleen injury revealed that the findings of each method were almost the same with few exceptions.

3. When liver/spleen injuries were classified according to the Japanese Association for the Surgery of Trauma (JAST) Classification of injury of liver and spleen, cases with emergency operation had severe injury of Type IIIb for the liver and Type IIIb or higher for the spleen, while conservative treatment was possible for injury cases of Type IIIa or lower of the liver and spleen. From these results, the JAST Classification of these injuries based upon CT imaging was found to be a suitable method for selecting an appropriate treatment for blund injury of liver and spleen.

Introduction

Recent studies have elucidated that the findings of injuries of parenchimatous organs such as liver and spleen by computed tomography (CT) are consistent with the findings under surgical operation[1)2)]. CT findings, however, provide only indirect information of injuries of parenchimatous organs. They are not indicative of the degree of the damage. It is still unclear whether CT findings can determine operative indication. We performed a retrospective study on such cases at our hospitals to examine whether CT findings can determine the severity of damage to these organs and operative indication for the injuries.

Subjects and Methods

All cases were subjected to contrast CT. Contrast medium (30.62% iopamidol, 40～200

Table 1 JAST Classification of injury of liver and spleen

Liver		Spleen	
Type I	subcapsular injury	Type I	subcapsular injury
a	subcapsular hematoma		
b	central rupture		
Type II	superficial injury	Type II	capsular injury
Type III	deep injury	Type III	parenchymal injury
a	simple type	a	simple type
b	complex type	b	transection
		c	complex type
		d	fragmentation
		Type IV	hilar vessel injury

Table 2 Correration of CT finding with operative finding for the patients with liver injury (n=23)

No.	Gender	Age	CT finding	Op. finding
1	M	17	I b	—
2	M	19	IIIa	—
3	M	32	I a	—
4	M	29	IIIa	IIIb
5	F	28	I b	—
6	M	26	IIIa	—
7	M	41	IIIb	IIIb
8	M	37	I b	—
9	M	34	I b	—
10	F	30	IIIa	IIIa
11	M	24	IIIa	—
12	M	41	IIIa	—
13	M	20	IIIa	—
14	M	52	I b	—
15	M	23	IIIa	—
16	M	16	—	I a (laparoscopic finding)
17	F	62	I a	—
18	M	27	II	—
19	M	48	IIIa	—
20	M	23	I b	—
21	M	24	I b	—
22	M	68	II	II
23	M	55	IIIb	IIIb

ml) was infused intravenously at a rate of 4 ml/sec using an automatic infusion system. Pictures were recorded after confirming the effect of imaging of vessels and parenchimatous organs. Additional contrast medium was infused appropriately when the imaging was insufficient[3].

The Japan Association for the Surgery of Trauma (JAST) Classification of injuries of liver and spleen was used to divide the injuries examined (Table 1)[4][5]. Herein, Type IIIa of both injuries indicates that all the injured regions maintain blood flow. To the contrary, Type IIIb liver injuries or Type IIIb-d splenic injuries indicate that the injured region has blood flow disorder.

Clinical Cases

During the period of May 1988 through December 1995, 33 clinical cases (28 males and 5 females) with a blunt injury of the liver and/or spleen were examined by CT at the Emergency Center of Tokyo Women's Medical College in Tokyo and the Department of Emergency Medicine of Fukui Medical School in Fukui. The 33 cases consisted of 21 cases of liver injury, 2 cases of complex injury of the liver and spleen, and 10 cases of splenic injury. The mean age of the patients was 33.1 years ranging between 16 and 68 years old.

Liver injury

Twenty-three cases with liver injury were diagnosed by CT imaging (Table 2). Nine cases were diagnosed as Type I (JAST), 2 cases as Type II, 9 cases as Type IIIa and 2 cases as Type IIIb (Fig. 1). One case (patient No. 16) did not show any abnormal findings by CT diagnostic imaging. Laparoscopic examination showed hepatic subcapsular hematoma with Type Ia in case No. 16.

When the CT findings were compared with the surgical findings in 5 cases of liver injury, the CT and surgical findings were consistent in 4 cases. One case (patient No. 4) was found to have a blood flow disorder in the injured parenchyma upon surgical operation and diagnosed as Type IIIb. This case was previously diagnosed as Type IIIa by CT imaging (Fig. 2). Thus it was not always easy to diagnose the

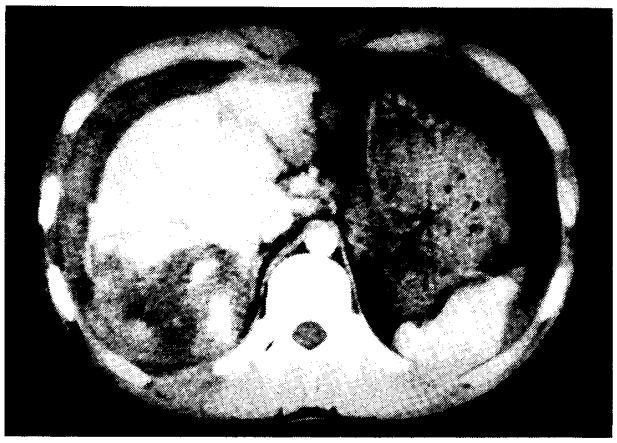

Fig. 1 CT finding of patient No. 7 showed deep injury of the liver and blood flow disorder in the injured parenchyma (IIIb).

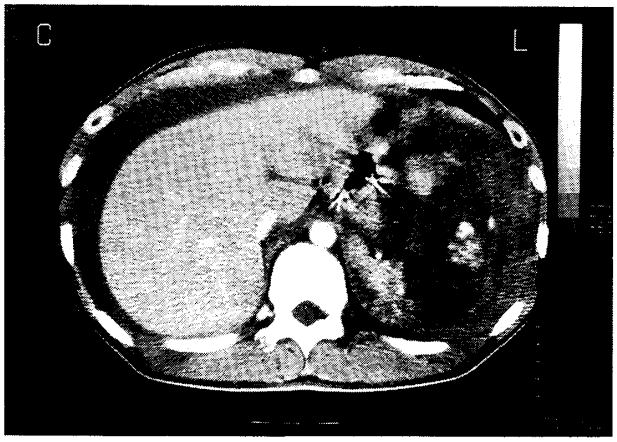

Fig. 3 CT finding of patient No. 25 showed fragmentation of the spleen (IIId).

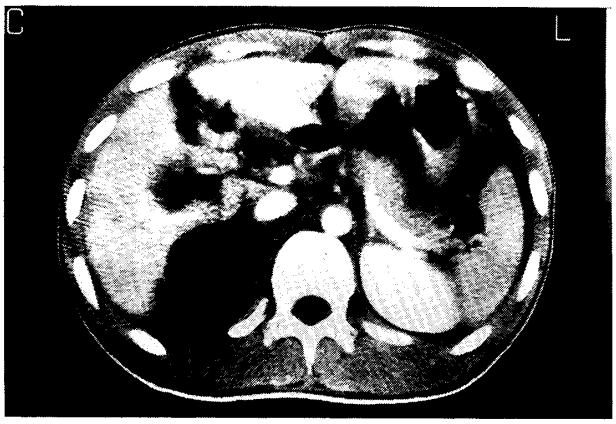

Fig. 2 CT finding of patient No. 4 showed deep injury of the liver and all of the injured region seemed to maintain blood flow (IIIa), however, surgical finding showed blood flow disorder in the injured parenchyma (IIIb).

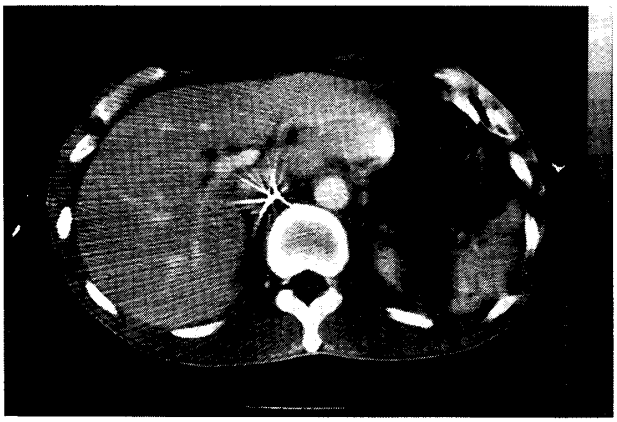

Fig. 4 CT finding of patient No. 29 seemed to be a transection of the spleen (IIIb), but laparoscopic finding showed the absence of damage to the splenic surface (IIIa).

presence or absence or blood flow disorder in the injured hepatic region.

Splenic injury

Twelve cases with splenic injury were diagnosed by CT imaging (Table 3). Seven cases were diagnosed as Type IIIa, 2 cases as Type IIIb, 2 cases as Type IIIc and 1 case as Type IIId (Fig. 3). One case (patient No. 29) was diagnosed as Type IIIb (transection of the spleen) by CT imaging (Fig. 4). Laparoscopic examination, however, confirmed the absence of damage to the splenic surface, the splenic attachment to the diaphragm, and corrected the splenic injury as Type IIIa. The CT findings

Table 3 Correration of CT finding with operative finding for the patients with splenic injury (n=12)

No.	Gender	Age	CT finding	Op. finding
22	M	68	IIIb	IIIb
23	M	55	IIIc	IIIc
24	F	28	IIIa	—
25	M	26	IIId	IIId
26	M	16	IIIa	IIIa
27	M	16	IIIa	—
28	M	42	IIIa	IIIa
29	M	40	IIIb	IIIa (CT+laparoscopic finding)
30	M	46	IIIa	—
31	M	33	IIIa	—
32	M	55	IIIa	—
33	F	29	IIIc	IIIc

Table 4 Patients with emergency operation (n=9)

No.	Injuries• Classification	Reason for surgery	Operative methods	Outcome
4	liver •IIIb	hemorrhagic shock	hepatectomy	survived
7	liver •IIIb	〃	〃	died
10	liver •IIIa	〃	〃	survived
	fractured kidney		nephrectomy	
22	liver •II	〃		
	spleen•IIIb		splenectomy	〃
23	liver •IIIb	〃	hepatectomy	died
	spleen•IIIc		splenectomy	
25	spleen•IIId	〃	splenectomy	survived
26	spleen•IIIa	suspected intestinal rupture	〃	〃
28	spleen•IIIa	〃	〃	〃
33	spleen•IIIc	hemorrhagic shock	〃	〃

were compared with the surgical findings in 6 cases with splenic injury. The degree of splenic injury was perfectly consistent in the CT and surgical findings.

Emergency operation for the liver and splenic injury

Of the 33 cases with liver or spleen injury, 9 cases (3 cases of liver injury, 4 cases of splenic injury and 2 cases of liver and splenic injury) were subjected to emergency surgery (Table 4). The operative indication in the 7 cases was dicided according to hemorrhagic shock, which had Type IIIb liver injury and Type IIIb or more severe splenic injury in 6 cases and in one case due to complicated renal rupture. The remaining 2 cases were diagnosed as Type IIIa of splenic injury and intestinal damage. The hemodynamic condition was stable in the 2 cases except for the evident symptoms of peritoneal irritation. The two cases were suspected to have intestinal damage as a complication and required surgery.

Regarding the outcome, 2 cases with Type IIIb liver injury subjected to hepatectomy died. The other 7 cases subjected to surgical treatment and 24 cases subjected to conservative treatment survival.

Discussion

Abdominal trauma is classified into two categories pathophysiologically; ① hemorrhage in the abdominal cavity due to injuries of parenchymatous organs or blood vessels, and ② peritonitis due to gastrointestinal perforation.

In the evaluation of the presence, degree and extent of injuries of parenchimatous organs such as liver and spleen, CT findings have been reported to be almost consistent with the findings obtained by surgery[1)2)].

From the pathophysiological point of view regarding injuries of parenchimatous organs, shock accompanying progressive intraperitoneal hemorrhage is an indication of emergency surgery. However, there have been few studies reported on the relationship between the severity of injury as diagnosed based on CT findings and hemorrhagic shock[6)], and there have been no studies about the types of injuries based on the JAST Classification and related methods of treatment to liver and splenic injuries. One of the purposes of JAST Classification of injuries of liver and spleen is that the classification of the type of injury can indicate the appropriate method of treatment to be selected [4)5)].

We classified our cases according to the JAST Classification of injuries of liver and spleen and performed a retrospective study about the usefulness of CT findings for diagnosing blunt injuries of the liver and spleen and for

deciding whether or not surgery should be indicated.

Of 35 lesions of 33 cases managed by us, the presence of liver/spleen injury was possible to demonstrate for 34 lesions (97.1%) based on CT findings. And in 12 lesions of 10 cases, CT classification of the injury could be compared with the surgical finding and/or laparoscopic finding. As a result, CT classification was completely correct in 10 lesions (83.3%). Two lesions in which CT classifications were not consistent with surgical or laparoscopic findings including one case of operation in which Type IIIb injury of the liver was erroneously diagnosed as Type IIIa by CT, and one case of laparoscopy in which Type IIIa injury of the spleen was erroneously diagnosed as Type IIIb by CT.

From these results, CT imaging is thought to be a thoroughly reliable diagnostic tool for the injury of the liver and spleen, except for some cases in which blood flow disorder to the injured region is suspected. Accordingly, it should be careful to diagnose type IIIa or type IIIb injury of the liver and/or spleen based on CT findings.

Among the cases with blunt injury of the liver and/or spleen, 6 required emergency operation due to hemorrhagic shock caused by damage to the liver/spleen. The type of injury was IIIb in 2 cases with liver injury, and IIIb or higher in 4 cases with splenic injury. All the injured regions had blood flow disorder. On the basis of these results, it can be judged that patients with liver/spleen injury which is diagnosed as type IIIa or lower based on CT findings are likely to undergo spontaneous hemostasis and show good response to conservative treatment. Accordingly, it is evident that CT findings provide important information for deciding operative indication for blunt injury of the liver/spleen. At the same time, we can evaluate the JAST Classification of injury of the liver and spleen as an appropriate selecting method for treatment of blunt injury of the liver and spleen.

Summary

CT findings of 35 lesions of 33 cases with blunt injury of the liver/spleen were retrospectively studied, and the following results were obtained.

1. Based on CT findings, the presence of injury was confirmed in all cases except for one lesion.

2. Comparison of CT findings and operative or laparoscopic findings in 12 cases undergoing surgery or laparoscopy for liver/spleen injury revealed that with few exceptions, the findings of each method were almost compatible.

3. When liver/spleen injuries were classified according to the JAST Classification of injury of liver and spleen, cases undergoing emergency operation had severe injury of Type IIIb for the liver and Type IIIb or higher for the spleen, while conservative treatment was possible for cases of Type IIIa or lower both for the liver and spleen.

From these results, the JAST Classification of injury of liver and spleen based upon CT imaging was found to be a suitable method in selecting an appropriate treatment for blunt injury of liver and spleen.

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肝・脾鈍的損傷のCTによる手術適応の判定

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肝・脾のような実質臓器の損傷に対するcomputed tomography（CT）の所見が手術所見とほぼ一致することは，最近の報告により明らかになっているが，CT所見は実質臓器の損傷を間接的にとらえているのであって，損傷による侵襲の程度を直接とらえている訳ではなく，CT所見から手術適応を判定できるかどうかについては十分な検討がなされていない．肝・脾鈍的損傷で造影CTを施行した自験例33例（肝損傷：21例，肝・脾合併損傷：2例，脾損傷：10例）について，CT所見から手術適応の判定が可能かどうかをretrospectiveに検討し，以下の結論を得た．

1) CT所見から，損傷の存在は1損傷部位を除きすべて確認できた．

2) CT所見と手術または腹腔鏡所見を比較できた12例では，損傷程度は両所見でほぼ一致していた．

3) 肝・脾損傷を，CT所見で日本外傷学会肝・脾損傷分類にしたがって分類すると，緊急手術を要した症例は，肝IIIb型，脾IIIb型以上の高度損傷例であるのに対し，肝IIIa型以下と脾IIIa型以下ではいずれも保存治療が可能であった．したがって，CT所見は，肝・脾鈍的損傷の手術適応の判定にきわめて有用と考えられた．