CLOSED ABDOMINAL INJURIES

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In the past two or three decades, the incidence of closed trauma of the abdominal organs show a great increase. The incredibly intensified traffic, large scale industrial and home constructions as well as the mechanization of agriculture are assumed as chiefly responsible for this phenomenon.

Table 1

Cause of injury / Organs affected	Transport	Home	Industrial	Total
Liver	4	1	2	7
Spleen	7	5	—	12
Hollow organs	5	7	1	13
Kidney	2	2	—	4
Other organs	8	5	1	14
	26—52%	20—40%	4—8%	50

As demonstrated by table 1, of the total number of 50 closed injuries of the abdomen (representing the case material of the Surgical Clinic for the past 10 years), 26 cases or 52% are caused by traffic traumatism, 20 or 40% — home injuries and 4 or 8% — industrial.

The most frequently affected in closed abdominal traumas prove to be the parenchymatous organs — liver, spleen and kidney, next following the hollow organs — stomach, intestine, urinary bladder etc.

The mortality rate in injuries of the listed organs is estimated as yet as rather high. In isolated injuries of the liver, it amounts according to Kümmerle (1959) to 44%, according to Gögler (1962) — 33%, whereas Reiferschild, on the ground of a cumulative statistical review of 2600 injuries, gathered after the second world war, claims a mortality rate of 23 per cent. According to our personal case material, the average mortality rate of all injuries of the abdominal organs amounts to 45%, being the highest in combined injuries, next following isolated injuries of the liver, hollow organs and spleen (in the latter case it is the lowest — of 12 patients only one died). In combined injuries mortality rises up to 60—100% (Gögler — 1962). According to our case material, of a total of 3 combined traumas, in 2 the outcome was fatal.

All these figures are based on information received from the bigger hospitals and institutes, where diagnostical and therapeutical possibilities

are much greater. Naturally, the figures for the small hospitals are excluded, which is not irrelevant and would undoubtedly alter the percentage in negative sense.

According to the material presented by Seeholzer, in cases of closed abdominal trauma, the injury of the liver represents 7,10%, and that of the spleen — 15%. In our series, the percentage of injuries of the mentioned organs is substantially higher. As regards the liver, it is 14,3%, spleen — 28% and hollow organs — 26%.

Diagnosis of the injuries of abdominal hollow organs is comparatively easily established, due to the clearly outlined morbid picture of peritonitis, but, in instances of parenchymatous organ' involvement, it is rather difficult. The leading sign in all the cases observed by the authors was the pronounced in varying degree state of shock, induced by the intraabdominal hemorrhage. Pain on pressure was noted very often in the upper half of the abdomen. In half of the cases with hepatic rupture, spontaneous and pressure pain and defance — muscle rigidity — as well are noted in the right subcostal area. Radiation of the pain in the right shoulder is not a constant index. Uncertain is likewise the leukocytosis index (10—12 000). The hemoglobin in severe injuries is deprived of a particular value. In the latter instance the hematocrit is quite indicative.

In ruptures of the liver and spleen, the bi-phase break down is also known. The initially formed hematoma rapidly grows and gets frequently ruptured, with ensuing hemorrhage within the free abdominal cavity.

The symptomatics of the ruptured kidney is more definite. Apart of the above mentioned common signs, here the total hematuria is particularly indicative. However, it might be lacking, provided a total avulsion of the urinary tract in its pyelourethral segment, is present.

As already stated, in the past ten years (covering the period 1955—1965), a series comprising 50 patients with varying type and degree abdominal trauma was followed up.

Table 2

Injured organs Total number	Liver	%	Spleen	%	Kidney	%	Hollow organs	%	Undetermined trauma	%
50	7	14	12	25	4	8	13	26	14	28

Table 2 illustrates the distribution, incidence and percentage of the various organs, affected by trauma.

While the clinical picture in 36 patients justified an emergency surgical intervention, in the remainder 14 cases, the trauma was comparatively mild, manifesting itself clinically with a dull pain in different areas of the abdomen, thus rendering possible the adoption of a wait-and-see policy. Later, of these 14 patients, 3 underwent laparotomy due to developing intestinal paresis. The operative finding revealed retroperitoneal hematoma in the region of the mesenterial root — twice and hematoma of the major omentum — once.

For better clarity of the work, we are going to analyse the patients according to the organ involved.

Case material with injury of the liver. We draw special attention to this organ because of its importance and hazard for fatal hemorrhages. Besides that, whilst the injured spleen or kidney could be removed easily and without sequelae and thus definitive hemostasis achieved, the affected liver should by all means be conserved and treated in a manner guaranteeing the patient's salvage (table 3 and 4).

Table 3

Cases №	Age/Sex	Type of trauma	Injury of the liver	Concomitant trauma
1	19 m	home	Rupture of liver	—
2	40 m	traffic	„	—
3	41 m	industrial	„	Rupture of spleen
4	19 m	traffic	„	Fracture of ribs
5	32 m	traffic	„	Rupture of spleen
6	6 m	traffic	„	—
7	25 m	industrial	„	Pelvic fracture

Table 4

№	Age/Sex	Hepatic condition	Operative approach	Concomitant injuries	Hospitalization in days	Outcome
1	19 m	Rupture of the cupula	Medial laparotomy	—	13	cured
2	40 m	Right lobe rupture	„	—	9	died
3	41 m	Multiple ruptures	„	spleen	30 min	died
4	19 m	Right lobe rupture	„	fracture of ribs	14	cured
5	32 m	Large right lobe rupture	„	spleen	10	died
6	6 m	Right lobe rupture	„	—	10	cured
7	25 m	Right lobe rupture	„	—	3	died

In seven patients of our series, injuries of the liver were found of varying degree and locality. They are illustrated in tables 3 and 4.

Before analysing the results of their treatment, we would like to make reference to the essentials in injuries of the liver in general.

In treatment of ruptures, firstly, the problem is confronted of the operative access to the organ. In the literature there are descriptions of 15 different approaches to this organ. In the majority of cases, however, the choice is upper medial laparotomy, being the preliminary diagnosis hardly convincing for the presence or not of injury in other organs. This incision provides for high degree atraumatic exploration and palpation of organs and if necessary, might be extended in the desired direction.

Upper medial laparotomy was sufficient in all our cases (table 4).

It is of utmost importance to make a wide and adequate incision, permitting (in the liver in particular) a thorough inspection and palpation with

the aim of establishing the ruptured areas. The careful palpation provides for the accurate detection of even minute fissures. In our series multiple ruptures were discovered in two instances.

Most of the injuries are situated in the right hepatic lobe. The access to the said portion of the liver is difficult — a fact necessitating the use of the following technique:

Lig. falciforme is cut anteriorly, beneath the diaphagm and grasped with a clamp. Thus, the liver is mobilized and accordingly dislocated, allowing operating with ease along its entire length. In extensive ruptures, overlying the cupula and posteriorwards, the patient should not be further traumatized and therefore, access should be gained through the sinus phrenicocostalis, after turning the patient. In simultaneous rupture of the kidney, usually a single transverse incision is performed.

The hepatic rupture represents a wound, lacerated in various directions. In many instances, detachment of varying size particles is observed, which should mandatorily be removed. Occasionally, it is also necessary to remove portions of the parenchyma with the goal to level the ruptured surfaces, preferably in acute manner (with scalpel or diathermy) prior to the blunt division. Such a debridement obviates postoperative febrile states (necrotic tissues resorption) and hastens the healing. In instances of pronounced lateral rupture of the liver, the lateral resection is preferred because of the hazard of necrosis, abscess and temperature. The major blood vessels are ligated individually with transfixing cat gut ligatures.

Closure of the hepatic wound is accomplished in the following way: suture of the liver is carried out with a large, rounded, edgeless needle, with average thickness cat gut threads. The single stitches are made at about 1 cm distant from each other, in deepness and invariably interrupted. In addition, a flap of pediculated omentum or preparations with hemostatic effect (in the form of sponge) are placed within the wound surface and above them the single cat gut stitches are tied. Mattress sutures, crisscross sutures and packing sutures are not advised. Tying should be made with graduated tension for avoiding division of the parenchyma. Over the liver a rubber or plastic drain is inserted, removed after 3—6 days.

The pediculated omentum, applied on the hepatic wound, serves as drainage through which the toxins, produced by the parenchymatous necrosis, are discharged. A great many complications are obviated in this manner.

The interposition of a free omentum flap, muscle fibers or fascia is considered harmful, as the dead tissue could, at any time, develop necrosis and abscess.

As already pointed out, our survey on seven injuries of the liver is illustrated in tables 3 and 4. The chief cause of the injury is street traumatism — 4, industrial traumatism — 2 and fall from a tree — one.

In four of the patients concomitant injuries are established: simultaneous involvement of the spleen and small intestine — 2, fracture of ribs and other bones — two.

Insofar locality of the rupture is concerned, the right hepatic lobe was involved in four instances, in two the ruptures were multiple and were accompanied by ruptures of the spleen and in one the lesion overlied the cupula.

Upper medial laparotomy was sufficient, in all subjects operated upon, for the thorough exploration and treatment of the rupture. Four of the patients died, two of them in the first postoperative hour, owing to severe shock. These are the cases with combined injuries. One of them died on the ninth day from intoxication and another one — on the third postoperative day from delayed shock. The three cured patients were with comparatively minor fissures in the right hepatic lobe and were hospitalized 12—13 days in the average.

Inferences

1) As obvious from the case material survey, though limited in number, the liver injuries appear to be among the most severe.
2) Mortality rate is very high — up to 60 per cent.
3) Combined injuries are rather frequent. Mortality in the latter case, especially in concomitant spleen rupture, reaches 100 per cent.
4) Upper medial laparotomy is the operative access of choice. In all instances it proved to be sufficient for the adequate treatment of the injury, regardless of locality.

Case material with injury of the spleen. This group of patients is presented in tables 5 and 6.

Table 5

№	Age/Sex	Type of trauma	Injury of the spleen	Concomitant trauma
1	9 ♂	traffic	Rupture of the spleen	Rupture of the stomach
2	8 ♂	sports	„	—
3	7 ♀	traffic	„	—
4	9 ♂	home	„	—
5	32 ♂	traffic	„	Rupture of the kidney
6	30 ♀	traffic	„	Pelvic fracture
7	5 ♂	traffic	„	Fissura renis
8	14 ♂	home	„	Pelvic fracture
9	26 ♂	traffic	„	Rupture of the kidney
10	11 ♀	home	„	—
11	18 ♀	traffic	„	—
12	41 ♂	traffic	„	Rupture of the liver

The chief cause, responsible for injury of the spleen, here too is the traffic (street) traumatism, established in 8 of a total of 12 cases; 4 are home injuries and 1 — industrial trauma. Isolated injuries of the spleen are discovered in five cases and the remainder are in combination with various organs and systems.

All patients are subjected to operation through upper medial laparotomy, but in two, in whom nephrectomy was considered imperative, the incision was combined with transverse extension to the leftside. Only three patients with combined injuries died. Of them, two are with simultaneous rupture

Table 6

№	Age/Sex	Operative approach	Type of operation	Concomitant injuries	Hospitalization in days	Outcome
1	9 m♂	Upper medial laparotomy	Splenectomy	Rupture of the stomach	5	died
2	8 m♂	„	„	—	7	cured
3	7 f	„	„	—	13	„
4	9 m♂	„	„	—	10	„
5	32 m♂	Upper medial with left extension	„	—	23	„
6	30 f♀	„	„	—	10	„
7	5 m♂	Upper medial laparotomy	„	—	14	„
8	14 m♂	„	„	—	28	„
9	26 m♂	Upper medial with leftside extension	Splenectomy+ Nephrectomy	Rupture of the kidney	11	„
10	11 f♀	Upper medial laparotomy	Splenectomy	—	34	„
11	18 f♀	„	„	Fracture of ribs	12	„
12	41 m	„	Splenectomy+ Hepatorrhaphy	Rupture of liver	1	died

of the liver (death caused by shock) and another one with concomitant rupture of the stomach who died from peritonitis. Healing in the remainder 10 patients occurred in varying terms of time ranging from 7 to 34 days.

Inferences

1) Spleen traumas in comparison to injuries of the liver are lighter.

2) Here too, the upper medial laparotomy provides for a convenient splenectomy. Extension in transverse direction was imperative merely when the injury was complicated by rupture of the left kidney.

Table 7

№	Age/Sex	Type of trauma	Injured hollow organ	Concomitant trauma
1	68 m♂	Traffic	Rupture of small intestine	—
2	30 m	„	„	—
3	30 m	Home	„	—
4	31 m♂	Traffic	„	—
5	80 m♂	Home	„	—
6	24 m♂	Traffic	Rupture of peritoneum	—
7	24 m♂	„	„	—
8	9 m	Home	Rupture of omentum	—
9	4 m♂	Traffic	Rupture of diaphragm	Rupture of pericardium
10	58 m♂	Farming	Rupture of small intestine	—
11	10 m	Home	„	—
12	57 m♂	„	„	—
13	32 m	„	Rupture of peritoneum	Retroperitoneal hematoma

3) The mortality rate is markedly lower than in liver lesions. It amounts to 23% and is chiefly conditioned by accompanying injuries. Death is caused by severe hemorrhagic shock within the first hours of the injury.

Case material with rupture of hollow abdominal organs This type of closed abdominal injury was observed in 13 patients, illustrated in tables 7 and 8.

Table 8

№	Age/ Sex	Condition of the intestine	Complications	Operative approach	Concomitant injury	Hospitalization in days	Hour of admission	Outcome
1	68 m	Laceration of small intestine	Diffuse peritonitis	Medial laparotomy. Intestinal resection	—	3	21	died
2	30 m	„	„	Medial laparotomy. Intestinal suture	—	30	1	healed
3	30 m	Rupture of small intestine	„	Medial laparotomy. Resection of intestine	—	21	20	died
4	31 m	Small intestine avulsion	„	„	—	5	20	„
5	80 m	Rupture of small intestine	„	Suture	—	3	21	„
6	24 m	Laceration of peritoneum	Retroperitoneal hematoma	Suture of peritoneum	—	12	2	healed
7	52 m	Rupture of small intestine	Diffuse peritonitis	Medial laparotomy intest, resection	—	3	19	died
8	9 m	Rupture of omentum	Retroperitoneal hematoma	Medial laparotomy	—	10	18	healed
9	4 m	Rupture of diaphragm	—	Thoracolaparotomy. Suture of diaphragm	Rupture of pericardium	30	22	healed
10	58 m	Rupture of small intestine	Diffuse peritonitis	Medial laparotomy. Intestinal resection	—	6	11	died
11	10 m	„	„	Intestinal suture	—	7	13	healed
12	57 m	„	„	Intestinal resection	—	3	16	died
13	32 m	Rupture of peritoneum	Retroperitoneal hematoma	Laparotomy	—	8	16	healed

The chief causes, responsible for injuries of the hollow organs of the abdominal cavity are: firstly, home injuries (falling on the abdomen, horse kick, direct blow on the abdomen etc.) and secondly, transport traumatism. It is almost a rule that ruptures are sustained after having a meal.

The small intestine is most frequently affected — 9 out of 13 cases. The defect was of varying degree, ranging from small fissure to total rupture of the intestine. In one of the patients the stomach and spleen were ruptured whilst the remainder sustained ruptures of the peritoneum and omentum with development of retroperitoneal hematomata.

Owing to the clinical picture presenting peritonitis in progress, all patients were subjected to operation by means of medial laparotomy. The treatment of the intestine was accomplished in accordance with the extent of rupturing. Resection of the small intestine was carried out in the majority of cases. The outcome in the latter procedure is estimated as the worst of all the series, presumably, on account of the marked discharge of intestinal content into the vacated abdominal cavity. Standard suture is applied merely in three cases.

The majority of the patients presented or were referred to the clinic rather late, which fact, undoubtedly, exerted an unfavourable effect on the final outcome of the injury.

Inferences

1) In closed injuries of the abdomen, the small intestine is proved to be most frequently lacerated among hollow organs.

2) Associated injuries of other organs are very rare.

3) The most common cause for the trauma of hollow abdominal organs is the direct blow or fall on the abdomen.

4) The high mortality rate is surprising (57%); in most of the cases it occurs within the first three postoperative days.

5) The main cause for lethal outcome is intoxication resulting from generalized peritonitis.

6) The late presenting of the patients at the clinic is rather impressing.

Case material with injury of the kidneys. This type of injury in blunt traumas of the abdomen was observed in four patients, illustrated in tables 9 and 10.

Table 9

№	Age/Sex	Type of trauma	Injury of the kidney	Concomitant injury
1	7 f	Traffic	Fissure of the right kidney	—
2	14 m	Home	Fissure of left kidney	—
3	32 m	Home	Rupture of left kidney	Rupture of spleen
4	26 m	Traffic	Rupture of left kidney	Rupture of spleen

Injuries of the kidneys, here too, are attributed to traffic and home traumatism. Insofar degree of trauma is concerned, in some cases (№ 1 — table 9) a small fissure is established, clinically manifested by a moderate hematuria, making unnecessary operative intervention. The second case was with massive hematuria and the large fissure was detected no sooner than at operation but nevertheless, suturing was performed.

Table 10

№	Age/Sex	Condition of the kidney	Operative approach	Concomitant injury	Type of operation	Hospitalization — days	Outcome
1	7 f	Slight fissure	—	—	—	8	healed
2	14 m	Large fissure	Lumbotomy	—	Suture	14	„
3	32 m	Rupture of left kidney	Lumbolaparotomy	Rupture of the spleen	Nephrectomy Splenectomy	23	„
4	26 m	Rupture of left kidney	Lumbolaparotomy	Rupture of the spleen	Nephrectomy Splenectomy	11	„

The remaining two cases were with combined injuries — rupture of the spleen. With them, the spleen and left kidney were simultaneously removed, resorting to extensive lumbolaparotomy. Regardless of the heavy shock, in all three patients venous urography was performed prior to operation for verifying the presence of a second kidney. All patients healed within varying terms of time.

Finally, we would like to present a brief characteristics of the remaining eleven patients with different traumas within the abdominal area. All of them were treated conservatively and healing occurred after various periods of time. The symptomatology in these patients did not warrant accepting disastrous lesion of some of the abdominal organs, and therefore, a "wait-and-see" policy was adopted with them. Erythrocytes were discovered in the urine of some patients without being possible to make a definitive statement for the presence or not of renal fissure.

ЗАКРЫТЫЕ РАНЕНИЯ БРЮШНОЙ ПОЛОСТИ

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РЕЗЮМЕ

Авторы сообщают 50 случаев с закрытыми травмами живота, которые наблюдались, в течение последних 10 лет, в кафедре хирургических болезней при ВМИ — Варна. Они находят, что 72% всех закрытых травм сопровождается ранениями разных органов, главным образом паренхиматозных и нуждаются в спешном хирургическом вмешательстве. Чаще всего поражаются паренхиматозные органы — печень, селезенка и почки. На втором месте — полые органы, а среди них, чаще всего, поранена тонкая кишка. Выше всего смертность при ранениях печени, и, в особенности, при одновременном поражении и других органов — селезенки, почки или кишки. В последних случаях смертность достигает 100%.

Выбор оперативного доступа при закрытых травмах живота, это медианная лапаротомия, которая, в случае необходимости, расширяется в одно или другое направление.