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Diagnostic laparoscopy for the acute abdomen and trauma

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Abstract
Background: We set out to investigate the potential benefits of routine diagnostic laparoscopy (DL) in cases of acute abdomen.
Methods: A prospective study of 120 DL in acute abdominal cases was performed in comparison with 310 similar acute abdominal cases treated without DL. The diagnostic accuracy, hospital stay, therapeutic delay, and convalescence time were then evaluated.
Results: DL established the indications for intervention in 96% of cases, yielded a diagnosis in 90%, and changed the treatment in 14%. The sensitivity achieved was 99.3%, specificity was 83.3%, and accuracy was 88.6%. There were two false positives, one false negative, and three results insufficient to make a diagnosis. Morbidity was one (0.8%), and mortality was one (0.8%). Seventy-nine patients (66%) were managed by laparoscopy and 24 by open interventions. The hospital stay in DL groups was shorter (median, 5 days vs 6 days in controls, $p < 0.0003$), as was the effective treatment time (median, 5 days vs 6 days, $p<0.0012$). The convalescence time was also shorter in DL groups (median, 14 days vs 14 days, $p<0.04$). Therapeutic delay occurred in 16% of the control group cases, doubling the morbidity rate, increasing mortality by 50%, and prolonging hospital stay (median, 9 days vs 6 days, $p>0.3$ (NS).
Conclusions: DL in the acute abdomen is a safe and accurate procedure that enables laparoscopic interventions and helps avoid nontherapeutic surgery. DL and appropriate treatment reduces hospital stay, therapeutic delay, and convalescence time.

Key words: Diagnostic laparoscopy — Acute abdomen — Abdominal trauma

The acute abdomen and abdominal trauma are the most controversial diagnostic issues in general surgical practice today [1, 4, 5, 23]. In 5–25% of patients, these diseases are detected on a delayed basis and misdiagnosed [9]. Delays reduce the effectiveness of treatment as well as increasing morbidity and mortality [1, 5]. The total cost of treatment rises due to prolonged hospitalization and convalescence time [15]. The unnecessary laparotomy rate in these cases is as high as 9–29% [1, 22]. Excessive observation time and sophisticated noninvasive diagnostic tests are not cost effective [12, 20].

Between 1996 and 1998, 2211 patients per year were admitted to our department; 193 (8%) were admitted because of an acute abdomen or abdominal trauma, and 16 (8%) of them died. Diagnostic discrepancy occurred in 29 acute abdominal cases (15%).

Despite newer and more effective noninvasive diagnostic tools, basic laboratory tests, plain abdominal radiographs, and ultrasound are used to assist the surgeon in the emergency room in making the diagnosis. The accuracy of radiography in these diseases reaches 75%, whereas the accuracy of abdominal ultrasound is 60–89%. The CT scan is more accurate (84–98%), but it is not always available [1, 5]. Invasive methods, such as abdominal puncture and diagnostic peritoneal lavage (DPL), can be applied with an accuracy of up to 91% [1]. However, only diagnostic laparoscopy or laparotomy can provide direct visualization of the disease or lesion [5, 16].

This report evaluates the possible benefits of the routine diagnostic laparoscopy performed in doubtful cases of acute abdomen, including abdominal trauma.

Materials and methods

Between 1993 and 1998, a prospective trial of 120 diagnostic laparoscopy (DL) procedures for suspected acute abdomen and abdominal trauma was carried out, and therapeutic laparoscopy (79 procedures) was done according to the indications. All patients were diagnosed and treated by the same surgeon. The criteria for entry into the study were: acute abdomen or abdominal trauma and equivocal noninvasive diagnostic results (e.g., laboratory tests, blind abdominal radiology, ultrasound whenever possible [100 cases], gynecological and urological consultations, etc.). Other laparoscopies in elective cases and cases where the source of complaints was clear, (e.g., cholecystolithiasis revealed by ultrasound) were excluded.

DL was performed promptly after admission to the department. Patients were hemodynamically stable, and all but two were examined under general anesthesia. Pulsoximetry and capnography were monitored.

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Table 1. Results of diagnostic laparoscopy in the group of patients admitted for suspected appendicitis (n = 42; M = 7, F = 35)

Diagnosis revealed by diagnostic laparoscopy	Number of cases
Acute appendicitis	35
Acute adnexitis	1
Appendicitis + adnexitis	3
Ruptured ovarian cyst	1
Omental torsion	1
Indication for laparotomy established (purulent peritonitis)	1
Total	42
Diagnosis established or disease excluded	41 (98%)
Indication for laparotomy without established diagnosis	1 (2%)

Conclusion: Diagnostic laparoscopy allowed a decision to be made in 100% of cases in this group

A pneumoperitoneum of 12 mmHg was established by left hypochondrial or transumbilical puncture. In cases of significant abdominal distension (20%), the pneumoperitoneum was created by transumbilical minilaparotomy. Two patients were examined under local anesthesia (8 mmHg). Two patients in the intensive care unit were laparoscoped through the drain openings after previous surgery because of suspected intestinal necrosis. The scope and two additional ports were used to allow the introduction of irrigation-aspiration cannulas, atraumatic retractors, etc. In most cases, the diagnosis was established promptly, and the decision to treat was made. In some cases, only the choice of surgery or conservative treatment was possible; in others, complete and adequate exploration of abdominal and pelvic cavity was needed to establish the negative diagnosis.

The patients were divided into the following three groups: suspected acute appendicitis—42, other acute abdomen of uncertain ethiology—54, abdominal trauma—24. They were compared with 310 acute abdomen and trauma patients admitted to the department in the years 1996–98 and diagnosed and treated without laparoscopy according to the indications (suspected acute appendicitis—157, other acute abdomen—115, abdominal trauma—38). The patients in the control group were treated by the surgeons in our department using the same protocol for management of the acute abdomen and blunt or penetrating trauma.

Parameters of diagnostic effectiveness were assessed. Hospital stay, therapeutic delay, and convalescence times were evaluated and compared for these groups. The results were analyzed statistically with the nonparametric Mann-Whitney U test, and $p<0.05$ was taken as significant. Hospital stay was defined as total stay in the department in days. Therapeutic delay was defined as discrepancy between hospital stay and effective treatment time counted from the day of operation to the day of discharge. Convalescence time was defined as the time in days of absence at work in working patients. In nonworking patients, it was the time needed to reestablish the previous condition after hospital stay, as assessed by the physician in the outpatient department. Patient age and leukocytosis were used as standardizing parameters to help compare the groups diagnosed by DL and those without DL. Degree of response to the interacting illness or trauma agent was considered as an approximate measure of its severity.

Results

Table 1 shows the results of the DL in 42 patients (35 female, seven male) with suspected appendicitis. In 35 of them, the preliminary diagnosis was confirmed; in one case, adnexitis was the cause of complaints; in three cases, both were found; and in three cases, other causes were found. In one case (1.2%) of purulent peritonitis, the indication for laparotomy was established; in the other 41 (97.6%), the correct diagnosis was made. Fifty-four cases of other suspected acute abdominal illness are presented in Table 2. There were five other diseases that presented as hepatic adenoma, Meckel's diverticulum, obstructed inguinal hernia, retroperitoneal tumor, or intra- and retroperitoneal hematoma after streptokinase treatment. In three cases, there were no changes. Diagnostic laparoscopy was able to establish the correct diagnosis in 48 cases, (89%), but it was insufficient for diagnosis in three cases (5.5%). There were two false positive (4%) and 1 false negative (2%) cases.

Table 2. Diagnostic laparoscopy in the group with uncertain acute abdomen diseases (n = 54; M = 27, F = 27)

Diagnosis	Number of cases
Hepatic and peritoneal metastases	5[a]
Adhesion ileus	10
Perforation of ulcer	7[a]
Acute appendicitis	6 (periappendicular abscess-1)
Adnexitis	3
Ovarian/tubal cyst	3
Intestinal necrosis	2
Cholecystitis	2
Sigmoid carcinoma	1
Diverticular disease (abscess, perforation)	2
Small bowel perforation	1
Intraabdominal hematoma after streptokinase treatment	1
Other	5
No changes	3[b]
DL insufficient for diagnosis	3
Total	54
Correct diagnosis established or disease excluded	48 (89%)
Diagnostic laparotomy (DL insufficient for diagnosis)	3 (5.5%)

[a] One false positive result
[b] One false negative result

In one false positive case, the ascitic fluid was mistaken as gastric juice due to perforation, although the perforation opening was never found. Doubt led to the negative laparotomy in one hepatic failure; fortunately, the patient recovered uneventfully. Another false positive DL (in terms of diagnosis, not the decision for treatment) was a diagnosis of neoplastic dissemination, which was corrected by histopatology to one of tuberculosis. This error, which is usually difficult to detect [3], did not alter the treatment, which is conservative under any circumstance. The source of one false negative was the misdiagnosis of a small ileal perforation caused by a conspicuous vegetable fiber in a 65-year-old man. Fortunately, the accidental tear to the arcade of mesenteric artery and subsequent hemorrhage provoked conversion to the open procedure; deliberate abdominal inspection of the intestine after ligation of the vessel revealed the perforation. After the suture, the patient healed uneventfully. In three cases, DL was considered insufficient for diagnosis. In one of these cases, the intraabdominal fluid was equivocal; at laparotomy, the fluid was diagnosed as ascites. In the second case, a 55-year-old woman had been admitted with severe abdominal distension. DL revealed a largely distended colon, and the abdominal cavity could not be explored. Because laparotomy resulted in tearing of the distended serosa, only colostomy was performed, leading to a 10-day delay of the surgery needed for this patient's ob-

Table 3. Diagnostic laparoscopy (DL) in trauma patients (*n*, 24; blunt trauma, *n*, 19; penetrating trauma, *n*, 5; M, 22; F, 2)

Diagnosis	Number of cases	Procedure		Morbidity	Mortality
		DL only	Therapeutic laparotomy		
Splenic tear	7[a]	—	Splenectomy—7	Subphrenic abscess—1	Polytrauma—1
Hepatic tear	1	—	Suture—1	—	Polytrauma—1
Intestinal tear	2	—	Intestinal sutures—2	Peritonitis—ileal resection 1 (healed)	Polytrauma—1
Retroperitoneal hematoma	1	—	Nephrectomy—1	—	—
Subhepatic hematoma	1	1	—	—	—
Indication for laparotomy—intraabdominal blood	4	—	intestinal resection—2, hepatic wound tamponade—1, mesenteric suture—1	Sigmoid perforation—sigmoid resection—1, ileus—1	—
No changes	8	8	—	—	—
Total	24	9	15	4	3

[a] Indication for laparotomy in one case only; no false results

structive sigmoid carcinoma. In the third case, a 77-year-old man with an ASA III status was suspected for perforation. DL revealed a retroperitoneal mass that elevated the mesenterium and compromised the laparoscopic view. No other cause was found. Nevertheless, DL was considered insufficient, and laparotomy was performed. No other lesions were found, but the patient's condition deteriorated. He died of cardiorespiratory insufficiency 3 days later. Thus, one complication (2%) and one death (2%) occurred in this group.

In addition, DL revealed two cases of total intestinal necrosis. Laparotomy was performed in an attempt to find some surgical solution to the poor status of these patients. Since there were no options, the abdomen was closed. Both patients died two days later. In these cases, DL was also considered accurate.

In 24 cases of abdominal trauma (19 blunt and five penetrating) (Table 3), the indications for treatment were established in all cases, the diagnosis was possible in 19 cases (79%), and the indication for surgery only was established in five cases (21%). There were no false results or complications due to DL. As a result of DL, seven open splenectomies, one hepatic suture, and one tamponade of hepatic wound were performed by laparoscopy. Two patients underwent intestinal resection and two others had suturing of the intestine, one of them by laparoscopy. There was also one nephrectomy to treat a large right retroperitoneal hematoma that had been revealed by DL.

Morbidity after surgery in this group was four, including one sigmoid perforation 4 days after an operation for blunt abdominal trauma when this fragment of injured colon was judged not to require any repair, one case of subphrenic abscess after splenectomy, and one ileus. In another patient sutured by laparoscopy because of penetrating wounds of the distal ileum, one wound of four was missed. Although the sutured wounds healed promptly, the untreated one caused peritonitis with very discrete local signs of leakage of intestinal juice, moderate distention, and slight tenderness. Leukocytosis and tachycardia were also present. Laparotomy, which was performed the next day, revealed severe peritonitis, requiring resection of the affected ileal fragment. The patient healed within 14 days.

There were three deaths as a result of polytraumatic lesions unrelated to the abdominal trauma. The overall results of the DL in the three subgroups are shown in Table 4.

Two different levels were evaluated—DL as a method of establishing the indication for surgery and DL as a tool for diagnosing. While the sensitivity, specificity, and accuracy for establishing the indication for surgery were extremely high, the diagnostic parameters were lower. Nevertheless, the diagnostic benefit was achieved in 115 patients (95.8%) (missed tuberculous lesions were treated conservatively, as for neoplasia). Compared to diagnostic peritoneal lavage, DL has the advantage of direct localization of the lesion or at least narrowing the area, which modifies the surgical access. In parameters of effectiveness, DL also outperforms DPL. Nine results insufficient for diagnosis (7.5%) and three false results (2.5%) compromise the method's efficacy, but these are generally surgeon-dependent factors, that can be minimized with further experience.

Overall, in 108 of 120 cases (90%), the changes were discovered by DL. Nontherapeutic laparotomy was avoided in 14% of patients, promoting prompt additional treatment if necessary (e.g., chemotherapy) and reducing possible complications. Diagnostic laparoscopy corrected the diagnosis in 43% of cases, confirmed the preliminary diagnosis in 47% of cases, and changed the treatment in 14% of cases. The morbidity due to the procedure was one case (0.8%), and mortality was also one case (0.8%), which seems acceptable. In five cases in the abdominal trauma group where only intraabdominal blood was found without defining the site and severity of the lesion, the amount of blood found (grade moderate and severe according to Berci's classification [12]) forced the surgeon to interrupt the diagnostic procedure and convert it to curative laparotomy.

The patients diagnosed by DL were treated in 79 cases (66%) by laparoscopic surgery, in 24 cases (20%) by open surgery, and in 17 cases (14%) only by DL. The surgery was completed by laparoscopy in 68 patients (57%); 11 patients were converted to open surgery (four deliberate and six forced conversions); morbidity was seven (9%), and mortality was two (2.5%). Patients diagnosed by DL were compared with 310 patients admitted to the department for suspected acute abdomen and trauma. In 246 of them (79%), surgery was perfomed; 64 (21%) were treated without op-

Table 4. Summary of the results of diagnostic laparoscopy (DL) in the evaluated material of patients (*n*, 120; M, 56; F, 64)

Parameters	Group I (suspected acute appendicitis)	Group II (uncertain acute abdominal disease)	Group III (abdominal trauma)	All groups (total)
Number of DL	42	54	24	120
Value of DL to establish an indication for operative treatment or not				
Sensitivity	100%	97.9%	100%	99.3%
Specificity	100%	66.7%	100%	88.9%
Accuracy	100%	88.9%	100%	96.3%
Value of DL to establish the diagnosis				
Sensitivity	100%	97.9%	100%	99.3%
Specificity	100%	50%	100%	83.3%
Accuracy	97.6%	88.9%	79.2%	88.6%
False positive result	0	2 (3.7%)	0	2 (1.7%)
False negative result	0	1 (1.9%)	0	1 (0.8%)
Result insufficient to establish indication for operation	0	3 (5.6%)	0	3 (2.5%)
Result insufficient to establish the diagnosis	1 (2.4%)	3 (5.6%)	5 (20.8%)	9 (7.5%)
% of changes stated by DL	41/42 (97.6%)	48/54 (88.9%)	19/24 (79%)	108/120 (90%)
Nontherapeutic laparotomy avoided	1 (2.4%)	7 (13%)	9 (37.5%)	17 (14%)
DL corrected diagnosis	8 (19%)	26 (48%)	18 (75%)	52 (43.3%)
DL increased precision of diagnosis	33 (79%)	22 (41%)	1 (4%)	56 (46.6%)
DL changed treatment	1 (2.4%)	7 (13%)	9 (37.5%)	17 (14%)
DL morbidity	0	1 (1.9%)	0	1 (0.8%)
DL mortality	0	1 (1.9%)	0	1 (0.8%)

Table 5. All acute abdomen and trauma patients diagnosed and treated by DL (*n*, 120) vs all control groups treated without DL (*n*, 310)

Group	Parameters	Age (yr)	Leukocytosis (/mm3)	Hospital stay (days)	Effective treatment time (days)	Convalescence time (days)	Mortality (days)
DL and appropriate	Minimal	13	3320	0.125	0.125	0	0.125
treatment	Maximal	79	27,000	77	77	165	36
(*n* = 120)	Median	39	11,550	5	5	14	3
No DL and appropriate	Minimal	14	1100	1	1	2	1
treatment	Maximal	88	34,400	61	61	112	49
(*n* = 310)	Median	38	12,100	6	6	14	5.5
Statistical significance, $p < 0.05$		$p > 0.4$ (NS)	$p > 0.5$ (NS)	$p < 0.0003$ (S)	$p < 0.0012$ (S)	$p < 0.04$ (S)	$p > 0.7$ (NS)

eration (Table 5). Both groups were comparable in terms of age and leukocytosis ($p>0.4$ NS, $p>0.5$ NS, respectively). The hospital stay was significantly shorter in the DL group than in controls (median, 5 days in the DL group vs 6 days in control group, $p<0.0003$). Also, the effective treatment time was significantly shorter in the DL group (median, 5 days in the DL group vs 6 days in controls, $p<0.0012$). Median convalescence times were equal (14 days vs 14 days, $p<0.04$), but the time in the DL group was also significantly shorter than in the control group. The time till death in nine patients of the DL group (5.5%) and 12 controls (3.9%) suggested shorter times in the DL group (median, 3 days vs 5.5 days, $p>0.7$), but this result was insignificant.

Table 6 and Table 7 show the analysis of the influence of therapeutic delay on morbidity and mortality in the operated cases of the control group. Most of the delays were 1 day only, due to hospital observation of the unclear appendicitis. Delays of 2 or more usually occurred in the suspected ileus cases, which were checked by abdominal radiopaque passage in attempt to treat them conservatively. All DL patients were diagnosed and treated without any delay. In 40 therapeutic delay cases that were subsequently operated on, morbidity was 11 (27.5%) and mortality was three (7.5%), as compared with a morbidity of 13 (6.3%) and a

Table 6. Therapeutic delay and its significance in the group without diagnostic laparoscopy with operative treatment

Therapeutic delay	Number of cases *n* (%)	Morbidity *n* (%)	Mortality *n* (%)
1 day	27 (67.5)	4 (14.8)	2 (7.4)
2 days	8 (20)	5 (62.5)	1 (12.5)
>2 days	5 (12.5)	2 (40)	0
Total	40 (100)	11 (27.5)	3 (7.5)
Rest of the control group without delay	206	13 (6.3)	7 (3.4)

Table 7. All cases operated with therapeutic delay in the control group (n, 40) vs cases operated without delay from the same group (n, 206)

Group	Parameters	Age (yr)	Leukocytosis (/mm3)	Hospital stay (days)	Effective treatment (days)	Convalescence (days)	Suppuration // mortality
Therapeutic	Minimal	15	1100	4	3	7	6 (15%)
delay	Maximal	86	37,800	33	24	45	//
(n = 40)	Median	43.5	12,300	9	7.25	30	3 (7.5%)
No therapeutic	Minimal	14	1060	1	1	5	9 (4.3%)
delay	Maximal	85	31,000	162	162	112	//
(n = 207)	Median	38	12,850	6	6	21	9 (4.3%)
Statistical significance, $p < 0.05$		$p > 0.5$ (NS)	$p > 0.4$ (NS)	$p < 0.002$ (S)	$p > 0.3$ (NS)	$p > 0.5$ (NS)	—

mortality of seven (3.4%) in the control group of 206 cases operated on without delay. The longer the delay, the higher the morbidity and mortality. Hence, therapeutic delay increased the morbidity more than four times and doubled the mortality rate. Although the median hospital stay was significantly longer due to the therapeutic delay, the effective treatment time was 1.25 days longer in the delay group (median, 7.25 days vs 6 days in the group without delay, p>0.3 NS), and the convalescence time was insignificantly longer in the delay group than the one without delay (median, 30 days vs 21 days, respectively, p>0.9).

Table 8 shows the possible influence of negative diagnostic laparoscopy on the hospital stay and convalescence times in the patient subgroups. Median hospital stay was 2 days shorter in the DL group (3 days vs 5 days, p>0.1 NS) than in the controls. Median convalescence time was the same (7 days vs 7 days, p>0.6 NS). These data support the thesis that DL has a beneficial effect, even if it is negative. The mortality shown for the DL group was not DL-dependent but was attributed to the discovered fatal disease.

Table 9 shows the treatment times in groups of abdominal trauma diagnosed by DL and treated by open surgery if needed, as compared with groups without DL treated the same way. The median hospital stay and effective treatment times were comparable (7 days vs 6 days, p>0.7, NS), despite two cases of 1-day delay. This supports the thesis that prompt diagnosis and treatment are needed in most trauma cases. Median convalescence time was longer in the DL group but insignificantly so (30 days vs 14 days, p>0.5). Morbidity was lower in the DL group, but mortality was lower in the open surgery group. These data confirm the safety of DL.

Discussion

This study, albeit prospective, seems to be somewhat randomized since the patients were diagnosed and treated in the emergency unit and admitted at random by a surgeon proficient in laparoscopy or by surgeons who did not use this method.

In several papers addressing diagnostic laparoscopy in the acute abdomen, especially in abdominal trauma, the only benefit found for DL was its ability to assess whether or not there is an indication for surgery [7]. DL can answer this question with 96–98.8% accuracy [1]. However, DPL can also answer this question with an accuracy rate of 91–98%, and it is less expensive [1]. But the diagnostic potential of DL lies in its ability to establish the proper diagnosis based on fact rather than presumption. In this series, the accuracy rate was 88.6%, and it seems to improve according to the learning curve. In some instances, DL can even play a role of a "diagnostic picklock" when other diagnostic noninvasive tools are not available and a laparoscopy set is at hand, as has been reported from developing countries [17].

Another advantage of this diagnostic method is that it provides a prompt diagnosis, thus saving on hospital stay. Costs are increased at the beginning, but they are ultimately decreased by the shorter hospitalization, omitting the costs of prolonged diagnostics, therapeutic delay, and potentially higher complication and mortality rate [4, 7, 15]. Even if DL is negative, the hospital stay is usually shorter than clinical observation without DL [7]. DL performed in some circumstances (e.g., abdominal disseminated neoplasia) can minimize the operative trauma and promote simple interventions [23] such as colostomy. When colostomy is done by the open method, it can provoke fistulas or nonhealing wounds, prolonging the patient's hospital stay, if he or she is in poor condition, till the end of his life.

In patients with acute abdominal disease, the logical consequence of DL was the effort to treat the disease by therapeutic laparoscopy [4, 6, 9, 19]. In this study, only 57% of patients were satisfactorily treated this way. Other authors have reported that 62–87.9% of their procedures could be completed by laparoscopy [4, 6]. An algorithm of diagnostic and therapeutic procedures in the unclear acute abdomen and trauma cases is presented in Fig. 1. It describes the place and sequence of prompt diagnostic and therapeutic laparoscopy, which has proved to be a safe procedure.

Table 10 summarized review of the literature on diagnostic laparoscopy for suspected acute abdomen and chronic abdominal pains for the last 12 years (>25 cases). Despite some minor differences in this material, it seems clear that it was relatively easy to establish the proper diagnosis in these acute abdominal illnesses [9, 16, 19, 20, 22]. In cases of abdominal trauma, most authors only wanted to establish whether laparotomy was indicated or not (blood or gastric/intestinal fluid in the abdominal cavity in blunt trauma, or penetration of the wound through the abdominal wall in wounds suspected of penetration) [12, 13]. This information is sometimes considered to be sufficient [8].

There is some controversy between certain European and American surgeons over the management of patients with hemodynamically stable blunt abdominal trauma. The American group prefers conservative treatment in most

Table 8. Suspected acute abdomen in groups of patients with diagnostic laparoscopy (DL) only (n, 18) vs those treated conservatively with no DL (n, 37)

Group	Parameters	Age (yr)	Leukocytosis (/mm3)	Hospital stay (days)	Convalescence (days)	Morbidity	Mortality
	Minimal	20	5920	1	0	0	6
DL only	Maximal	77	26200	27	21		
	Median	48.5	10500	3	7		
No DL and	Minimal	18	4900	1	0	1	0
conservative	Maximal	88	19500	42	30		
treatment	Median	46	9100	5	7		
Statistical significance, $p < 0.05$		$p > 0.8$ (NS)	$p > 0.4$ (NS)	$p > 0.07$ (NS)	$p > 0.7$ (NS)	—	—

Table 9. Comparison of abdominal trauma groups: patients diagnosed and treated with diagnostic laparoscopy (DL) (n, 24) vs patients treated without DL (n, 38)

Group	Parameters	Age (yr)	Leukocytosis (/mm3)	Hospital stay (days)	Effective treatment (days)	Convalescence (days)	Morbidity // mortality
DL and appropriate	minimal	17	5120	0.125	0.125	0	4 (17%)
treatment	maximal	69	26,300	77	77	165	//
(n = 24)	median	34	11,000	6.5	6.5	30	3 (12.5%)
No DL and appropriate	minimal	18	4900	2	2	5	8 (21%)
treatment	maximal	81	28,100	162	162	112	//
(n = 38)	median	36.5	10,150	6	6	14.5	2 (5.3%)
Statistical significance, $p < 0.05$		$p > 0.3$ (NS)	$p > 0.2$ (NS)	$p > 0.8$ (NS)	$p > 0.8$ (NS)	$p > 0.9$ (NS)	—

cases and exploration if the treatment of discovered severe intraabdominal lesions is needed [11]. We tend to agree with the European surgeons [14], who argue that DL should be performed in every suspected case of blunt abdominal trauma, since the problem will be resolved immediately and the patient can be discharged on the next day or treated promptly according to the indications and abilities of the surgeon, sometimes by laparoscopy. Furthermore, in polytraumatic patients operated on under general anesthesia because of other lesions (cerebral, orthopedic, etc.), DL or diagnostic thoracoscopy is often the wisest choice in dubious cases because it can help to avoid further or even concomitant problems. In this series, two diagnostic thoracoscopies were performed—one in a patient with blunt trauma of the left thoracoabdominal region, another in a patient with penetrating stab wounds of the left thorax and abdomen. There was no thoracic drainage left. The damage caused by trauma to the chest was assessed as needing no operative intervention.

Some authors have raised serious concerns about performing DL in association with the brain trauma, since there is evidence that intracranial pressure is increased during pneumoperitoneum [10]. But other surgeons who have performed many DL in such circumstances have not observed any adverse effects associated with elevated intracranial pressure [24].

Most faults and mistakes (Table 10) occur when diagnosing chronic abdominal pain [8, 16, 23], perhaps because of the imprecise location of the disease or due to minute morphologic changes. In this situation, DL examination requires exceptionally high accuracy. Some surgeons solve this problem by means of a mini-laparoscopy performed under local anesthesia, in an attempt to achieve "conscious pain mapping." However, others claim that the method is

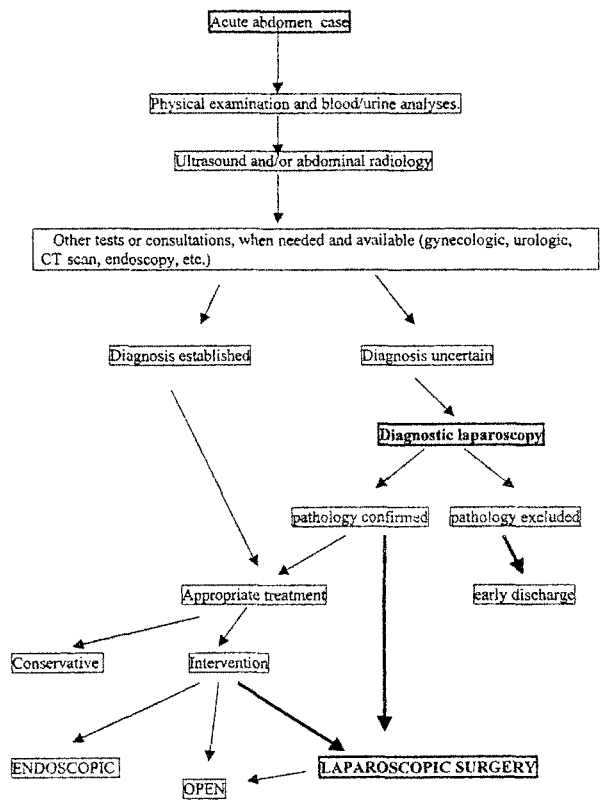

Fig. 1. Proposed algorithm of diagnostic and therapeutic procedures in the acute abdomen and trauma, including diagnostic and therapeutic laparoscopy.

Table 10. Review of the literature on diagnostic laparoscopy (DL) in the last 12 years (groups >25 cases)

First author [reference number]	Year	Number of cases	Acute abdomen	Blunt abdominal trauma	Penetrating trauma	Chronic abdominal pains	Indication to operate or not established *n* (%)	Cause found by DL *n* (%)	Nontherapeutic laparotomy avoided *n* (%)	Treated by laparoscopy (LO)	Treated by open operations	Accuracy in establishing of diagnosis %	Morbidity of DL *n* (%)	Comments
Paterson-Brown [19]	1986	31	31	—	—	—	18 (34)	25 (81)	18 (59)	—	13	81	0	
Nagy [16]	1989	53	31	11	—	11	18 (34)	47 (88)	30 (57)	—	18	87.6	10 (13)	
Easter [8]	1992	77	7	—	—	70	34 (44)	41 (53)	43 (56)	8	26	53	0	
Livingston [13]	1992	39	—	8	31	—	26 (66)	17 (35)	11 (28)	—	28	95	1 (2.5)	
Brandt [1]	1993	25	25	—	—	—	12 (48)	12 (48)	13 (52)	—	12	96	2 (8.0)	DL in ICU
Rossi [20]	1993	32	—	6	26	—	21 (66)	25 (78)	11 (34)[a]	—	32	97	2 (6.0)	No changes
Schrenk [22]	1994	59	15	9	—	31	43 (72)	51 (77)	16 (27)	40	9[a]	87	3 (5.0)	Conversions
Van der Velpen [23]	1994	150	40	—	—	45	45 (30)	85 (57)	105 (70)	25	20	82	0	
Geiss [9]	1995	155	155	—	—	—	154 (99)	154 (99)	11(7.0)[a]	154	6	99.4	1 (0.6)	Biopsies only
Orlando [18]	1997	26	26	—	—	—	15 (58)	16 (61)	9 (34)	6	9	97	1 (4.0)	DL in ICU
Present study	2000	120	96	19	5	—	117 (97.5)	108 (90)	17 (14)	79	24	88.6	1 (0.8)	10 conversions

[a] Accuracy only in establishing the diagnosis but not in finding the indications for operative treatment

ineffective and more painful and that insufflation (8 mmHg) is insufficient [21]. Mini-laparoscopy is especially efficient for rough examinations performed in the emergency room to establish the need for surgery. But this method is rarely able to provide exact diagnosis and treatment [12]

The more widespread the operative laparoscopy, the more important it is for the diagnosis to be highly adequate, outperforming the efficacy of other invasive diagnostic methods. As additional advantages, the DL method can be applied in the intensive care unit, [1, 18] or employed for better and safer diagnosis and treatment of HIV-positive patients [2]. In general, diagnostic laparoscopy for cases of acute abdomen and trauma can be easily performed in the general surgery department, but when the case is more complicated, more expertise in laparoscopic surgery is required. The use of every port to make an inspection that shows clear orientation of the anatomy deformed by disease of the abdomen and allows any free abdominal liquids to be identified should be considered; if the identification is equivocal inside the abdomen, it should be done extraperitoneally. In addition, the careful and meticulous exploration of distended bowel from one end to another can cause some problems [9]. Finally, the human factor influences the performance of laparoscopy as a tool of emergency diagnosis and treatment. Thus, it is important to convince the staff of its usefulness, especially at night when all personnel are not at their best. The promising results presented here can help to solve the problem of the acute abdomen as experience with this method increases.

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