Diagnostic Peritoneal Lavage in Acute Abdominal Disease:

Normal Findings and Evaluation in 100 Patients

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A PERSISTENT need for more accurate diagnostic methods exists in certain patients with acute abdominal disease. Diagnostic needle or catheter aspiration of the peritoneal cavity has been utilized sporadically to fill this need,[1, 2, 6, 8, 10, 12, 13] and information has accumulated regarding changes in peritoneal fluid in various disease states.[2, 4, 5, 9] However, the procedure has not become popular because it fails, in many instances, to provide a representative sample of the peritoneal fluid.[1, 2]

Recently diagnostic trocar-catheter peritoneal lavage has been reported by Root and colleagues to detect early post-traumatic intraperitoneal hemorrhage with great accuracy.[7] Accordingly, we embarked on an evaluation of diagnostic peritoneal lavage in patients with acute abdominal disease in the hope that the procedure would increase diagnostic accuracy, hasten necessary surgical therapy, and prevent unnecessary laparotomies.

This report describes results of this evaluation in 100 patients. In addition, it establishes normal or baseline values for the findings in diagnostic trocar-catheter peritoneal lavage and defines the detrimental effects of and the indications and contraindications for the procedure. By so doing, it attempts to place a potentially helpful diagnostic aid in its proper role.

Methods

For purposes of this study, all patients with signs or symptoms of acute abdominal disease seen on the Second Surgical (Cornell) Division at Bellevue Hospital over a 10-month period underwent a diagnostic peritoneal lavage. Eighty-six patients were on the surgical service and 14 were seen in consultation on the medical service. The final diagnoses in these patients are listed in Table 1. In all patients, diagnostic impressions and planned therapy were re-

TABLE 1. *Diagnosis in 100 Patients Undergoing Diagnostic Trocar-Catheter Peritoneal Lavage*

Perforated ulcer	8
Appendicitis	11
Ruptured spleen or intraperitoneal bleeding	9
Pancreatitis	10
Pelvic inflammatory disease	6
Mesenteric vascular occlusion	3
Bowel obstruction	3
Other perforations of G-I tract	3
Miscellaneous inflammatory conditions	11
No acute intraperitoneal disease requiring operation	36

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TABLE 2. *Normal Values for Trocar-Catheter Lavage Based on Findings in 14 Proven Normal Patients and 22 Patients Presumed on the Basis of Benign Course Not to Have Intraperitoneal Disease Requiring Operation*

Appearance	
Clear	25% (9 of 36 patients)
Cloudy or straw colored	28% (10 of 36 patients)
Pink or red	47% (17 of 36 patients)
pH	5.0–8.0
Protein	0–100 mg./100 ml. (0–2+)
White blood cell count	0–1,200 cells/mm.^{3}
Red blood cell count	0–129,000 cells/mm.^{3}*
Amylase	3–120 Somogyi units**
Gram stain	No organisms

* Mean = 15,200 cells/mm.^{3}; 94% < 75,000 cells/mm.^{3}

** Mean = 42 Somogyi units; 92% < 50 Somogyi units.

corded by the senior surgical resident prior to lavage and again after results were tabulated and included in the program of diagnosis and therapy.

Lavages were performed in a standard manner with the patient supine. If the abdomen was free of scars, a 1-cm. scalpel incision was made in the midline 4 cm. below the umbilicus under 1% procaine infiltration anesthesia. The subcutaneous fat, or anterior rectus fascia in thin patients, was grasped with two Allis forceps and pulled anteriorly. A 20-gauge spinal needle with a drop of fluid in its hub was advanced slowly between the Allis forceps until the fluid disappeared. Two hundred cubic centimeters of air were then injected. The patient, if cooperative, was told to tense his abdominal wall and a standard 15 French trocar was slowly advanced with a rotating motion and very gentle pressure. The trocar was aimed inferiorly and posteriorly in the mid-sagittal plane toward the center of the pelvic hollow.

The sharp trocar stylet was withdrawn frequently and an 11 French plastic catheter * advanced repetitively on a trial basis. Penetration of the peritoneum was confirmed by free passage of the catheter, which was directed into the dependent portion of the pelvic cavity. The catheter was aspirated. If less than 50 ml. of fluid was obtained, 1,000 ml. of normal saline were instilled. The patient was turned from side to side twice and the fluid allowed to drain out by gravity. This was facilitated by use of a peritoneal dialysis unit.**

If there were abdominal scars in the midline, secondary sites were utilized for insertion of the trocar at the lateral edges of one of the rectus muscles 4 cm. below the umbilicus. Care was taken to empty the urinary bladder prior to insertion of the trocar.

Aspirated fluid or returned instillate was examined for gross appearance, color, and odor. pH was determined by nitrazine paper; protein content was determined by tetrabromphenol blue indicator with citrate buffer *** and amylase was measured by the method of Somogyi.[11] Red and white blood cells were counted in a hemocytometer. When necessary, a 20:1 dilution with saline was made in a white blood cell pipette. A smear of the fluid was Gram-stained and examined microscopically for bacteria.

In 36 patients lavages were considered normal or indicative of no condition within the peritoneal cavity requiring surgical

* Supplied by Abbott Laboratories as Inpersol catheters, 11 Fr., 11 inches in length.

** Inpersol Set, Abbott Laboratories.

*** Albustix, Ames Company, Inc.

TABLE 3. *Normal Values for Catheter Peritoneal Lavage without Trocar Performed at Laparotomy for Non-Acute Abdominal Disease on 10 Patients*

Appearance	
Clear or straw colored	60% (6 of 10 patients)
Red or pink	40% (4 of 10 patients)
pH	5.0–7.0
Protein	0–100 mg./100 ml. (0–2+)
White blood cell count	0–10 cells/mm.^{3}
Red blood cell count	0–40,000 cells/mm.^{3}*
Amylase	10–76 Somogyi units**

* Mean = 6,380 cells/mm.^{3}; 40% ranged between 3,200 and 40,000 cells/mm.^{3}

** Mean = 34 units; 90% < 50 units.

treatment. Of these patients, 14 were shown at operation to have no acute intraabdominal disease, and 22 were presumed not to have acute surgical disease on the basis of subsequent benign courses.

In 10 additional patients peritoneal lavage was performed without a trocar at the time of laparotomy for hernia, chronic duodenal ulcer, or chronic cholecystitis. In these patients, blood from the incision was carefully excluded from the peritoneal cavity.

Results

1. Normal Values. The ranges of normal values for lavages are shown in Table 2. These ranges are derived from the 14 normal and the 22 presumptive normal lavages. When compared statistically, results in these two subgroups were not significantly different; hence, the groups were combined to give the ranges in Table 2.

Because it was suspected that the surprisingly high red blood cell counts in normal lavages resulted from insertion of the trocar, ten lavages were performed at laparotomy without a trocar on patients without acute abdominal disease. The range of values in these is shown in Table 3. The findings in these ten patients were comparable to those resulting in the 36 normal trocar lavages except for the lower white blood cell count and a slightly lower average red blood cell count.

TABLE 4. *Value of Diagnostic Peritoneal Lavages in 100 Patients*

	Number & Per Cent of Patients	
Major help (changed prior decision):	23	
a. Prevent unnecessary operation		11
b. Lead to operation not planned		12
Minor help (confirmed prior decision)	38	
Total	61	

2. Value of the Lavages. In 23 of the 100 patients, information provided by the lavage was of major diagnostic aid (Table 4). This was defined as information leading to reversal of the plan of therapy. In 11 patients, a planned but unnecessary operation was avoided on the basis of lavage findings. In 12 patients, lavage findings guided reversal of a decision not to operate and thereby hastened a needed operation (Table 5). In 38 additional patients, lavage provided minor assistance by confirm-

TABLE 5. *Lavage Findings Leading to Otherwise Unplanned Operation in 12 Patients*

Number of Patients	Diagnosis before Lavage	Lavage Findings Leading to Operation	Diagnosis after Lavage	Operative Diagnosis
3	Multiple trauma, unconscious	Free return of blood	Hemoperitoneum	Ruptured spleen
2	Abdominal pain, ?etiology	Bacteria, >9,000 WBC/mm.^{3}	Perforated viscus	Perforated ulcer
2	Vague abdominal pain, ?pancreatitis	Bacteria, foul odor	Infarcted bowel	Infarcted bowel
1	Coma and abdominal distension, ?etiology	Bile, bacteria, 64,000 WBC/mm.^{3}	Perforated viscus	Perforated ulcer
1	Thoracic stab wound, negative abdomen	Free return of blood	Hemoperitoneum	Lacerated spleen
1	Acute alcoholic gastritis	Free return of blood	Hemoperitoneum	Ruptured spleen
1	Multiple trauma, unconscious	600,000 RBC/mm.^{3}	Hemoperitoneum	Avulsed mesenteric root
1	Vague abdominal pain ?etiology	Bacteria >50,000 WBC/mm.^{3}	Perforated viscus	Small bowel perforation secondary to lymphoma

TABLE 6. *Misleading Lavages in 100 Patients*

	Number & Per Cent of Patients
Total misleading lavages:	11
a. False positive	10
Red blood cells*	7
White blood cells	1
Technical error	2
b. False negative**	1
Misleading lavages in light of current information	3

* Currently six of these would be within normal limits.

** In conditions producing generalized peritoneal reaction.

ing a therapeutic decision that was tenuous but correct.

3. Correlation of Lavage with Peritoneal Fluid. The lavage provided a representative sample of the peritoneal fluid in 91 of the 100 patients. The returned instillate was unrepresentative because of faulty catheter placement in two patients. These could have been prevented by the technical precautions outlined. In the other seven patients, the fluid was considered unrepresentative because of the presence of erythrocytes which could not be accounted for on the basis of the patient's primary disease. In view of our finding of red cells in roughly one-half of normal lavages, six of these seven lavages would no longer be considered unrepresentative. This would reduce the number of unrepresentative results to 1%.

4. Misleading Lavages. In 11 of the 100 patients, the lavage was originally considered misleading. Ten were falsely positive, and one falsely negative (Table 6). Of the ten originally believed to be falsely positive, six were due to the presence of red blood cells which would now be recognized as normal. Two were due to avoidable technical errors in catheter insertion. The remaining two, which even now would be interpreted as falsely positive, revealed in one an unusually high erythrocyte count and in the other an unusually high leukocyte count without explanation when the abdomen was explored. The only falsely negative result occurred when no bacteria were found in the lavage of a patient with an early mesenteric vascular occlusion. In only one patient, however, did the misleading lavage lead to erroneous therapy. This consisted of an unnecessary laparotomy in an unconscious hypotensive patient who had fallen six stories and who succumbed to a head injury. In the other instances, the lavage though misleading, was sufficiently inconsistent with other findings that it was disregarded or repeated and the proper decision reached.

5. Complications. No detrimental complication of the trocar catheter lavage occurred in these 100 patients (Table 7). However, five incidental complications occurred. Bowel was entered in one. This was detected by the nature of the fluid aspirated. The patient did well without specific therapy. The others (lacerations of mesentery, psoas muscle, bowel wall) were found at laparotomy and in no instance was there significant bleeding, although the lacerations probably contributed to the number of red blood cells seen in the lavage fluid. Since 46 patients did not have subsequent laparotomy, it is possible that more incidental complications occurred but were undetected. All complications occurred early in the series and increased attention to

TABLE 7. *Complications of Diagnostic Peritoneal Lavage in 100 Patients**

	Number & Per Cent of Patients
Detrimental complications	0
Incidental complications	5
Mesenteric laceration	2
Bowel entered	1
Psoas muscle laceration	1
Bowel wall laceration	1

* Although the incidental complications may have contributed to misleading lavages, none required specific therapy and no harm resulted.

technical details of insertion of the trocar probably accounts for decreased incidence.

Discussion

This study shows that peritoneal lavage is safe and, in certain patients, helpful. Like most other diagnostic examinations, however, it is not infallible and must be used appropriately. To avoid complications and confusing results, the procedure must be done with attention to technical details. It must be interpreted in light of other findings if the 3% misleading lavages are not to result in erroneous treatment.

Lavage results must be interpreted on the basis of normal values. The source of the red blood cells in normal lavage fluid remains unknown. Although some red cells must result from trocar insertion, erythrocytes in 40% of lavages done without a trocar suggest that the normal peritoneal cavity contains free erythrocytes.

It is also necessary to consider all findings in a given lavage before reaching a conclusion. For example, a high amylase level in the lavage fluid can be indicative not only of pancreatitis but also of infarcted bowel or perforated small intestine.[2, 3, 5] The latter two lesions can usually be ruled out if bile and organisms are not found in the peritoneal fluid. Furthermore, a lavage analysis should not be relied on if it is inconsistent with other findings. If a surgically treatable condition is suspected but not sustained by lavage results, repeated lavage or even laparotomy should be performed since it is possible that lavage can be negative in the early stages of diseases requiring operation such as perforated ulcer and mesenteric vascular occlusion.[4] Furthermore, a negative lavage should not supercede traditional indications for operation in localized inflammatory conditions such as appendicitis which may have little or no effect on the lavage findings.

For these reasons, diagnostic peritoneal lavage for acute abdominal disease is contraindicated under the following circumstances: 1) when the diagnosis can be made with clarity by standard means; 2) when there are multiple scars and distended bowel; 3) in the differential diagnosis of appendicitis and pelvic inflammatory disease; 4) in the differential diagnosis of an overt localized inflammatory process; and 5) in pregnancy.

Currently we believe that patients with acute abdominal signs or symptoms should be carefully selected for diagnostic peritoneal lavage according to the following indications: 1) puzzling diagnostic problems especially in high operative risk patients; 2) obtunded or uncommunicative patients with signs or symptoms suggesting the possibility of acute abdominal disease; 3) patients with suspected pancreatitis in whom non-operative therapy is planned; 4) patients with a history of recent abdominal trauma, especially those with multiple injuries; 5) drug addicts with acute abdominal symptoms; and 6) suspected non-surgical acute abdominal disease.

With selection and the precautions outlined the number of helpful lavages will be higher than in the series here reported.

Summary

Diagnostic trocar-catheter peritoneal lavages have been evaluated in 100 patients with potential acute abdominal disease. The fluid returned has been examined for gross appearance, and analyzed for pH, protein, amylase, red and white blood cells and bacteria. Normal ranges of values have been defined on the basis of 14 proven and 22 presumptive normal lavages with a trocar and ten normal lavages without trocar. Approximately half the normal lavages were pink or red in color and contained 3,200 to 75,000 red blood cells per cubic millimeter of lavage fluid.

In these 100 patients, 23 diagnostic lavages were of decisive help in management of the patients and 38 were of minor or confirmatory value. In view of technical modifications and normal values estab-

lished, only three of the lavages were misleading; two were falsely positive and one falsely negative. Only one lavage was not representative of peritoneal fluid. There were five incidental complications but none was detrimental or required therapy.

Diagnostic trocar-catheter peritoneal lavage, as an aid in diagnosis of the acute abdomen, is contraindicated when the diagnosis is clearly made by ordinary measures. Moreover, the procedure should *not* supercede or substitute for traditional methods of evaluating acute abdominal disease. The procedure is indicated and of value in selected patients in whom diagnosis is difficult because of intercurrent medical or surgical problems.

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