

## Percutaneous drainage of abdominal fluid collections that require laparotomy or relaparotomy with ultrasound guidance

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**Background.** The aim of the study was to determine efficacy and reliability of percutaneous abdominal drainage in surgical patients and to evaluate intercostal approach to drain subphrenic collections.

**Material and methods.** Eighty-seven patients aged from 29 to 84 years (mean, 55.5 years) were percutaneously drained under the sonographic guidance due to the postoperative or nonoperated abdominal collection that would otherwise require laparotomy. Intercostal, subcostal, lateral and anterior approach with eight to 14 French catheters were used to evacuate abdominal collection.

**Results.** The intercostal approach was used to drain 31 (60.8%) of 51 subphrenic collections. The mean duration of drainage was independent of the intercostal or subcostal drainage route, but was significantly prolonged ( $p < 0.05$ , Mann-Whitney U test) for purulent collections (median, 18 days; range 7-73 days) in comparison to hematomas, bilomas and other nonpurulent collections (median, 11 and 6 days, respectively). Sonographically guided percutaneous drainage was a definitive method in 92% patients, with 9.2% minor complications. Successful rate for subphrenic collections was even greater (96%).

**Conclusions.** Sonographically guided percutaneous drainage is the method of choice in the treatment of abdominal collections that require laparotomy. If the puncture site is at least two intercostal spaces lower than the dome of diaphragm and catheter is not introduced through the pleural effusion, intercostal drainage is equally efficient and not less secure than subcostal approach.

Key words: sonography; abdomen; drainage

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### Introduction

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Despite the initial skepticism, percutaneous catheter drainage of abdominal collections is well established and widely accepted procedure by an interventional radiologist and surgeons.<sup>1,2,3</sup> Fluid collections may be drained under the sonographic, CT or fluoroscopic

guidance. The intercostal or subcostal approach may be used to drain subphrenic collections. Subcostal drainage route is generally recommended to avoid pleural transgression.<sup>4</sup> The intercostal approach is preferred to drain left subphrenic collections after splenectomy.<sup>5</sup>

The aim of our study is to determine the efficiency and reliability of the percutaneous abdominal drainage in surgical patients, as well as to compare the transpleural and extrapleural approach to drain both right and left subphrenic collections.

### Material and methods

In five-years' period we planned 101 sonographically guided percutaneous drainages of the suspected abdominal collections in patients who were admitted at the surgery clinic. Only in 3 patients the intestinal interposition could not be avoided in any potential approach route, and percutaneous drainage was postponed or withdrawn. Percutaneous aspiration of the fluid content with or without instillation of antibiotics was a definitive method in 6 patients. In other five patients initial diagnostic needle aspiration confirmed solid lesion instead, and the aspiration biopsy followed.

Our study includes 87 patients, 46 male and 41 female, with percutaneous catheter drainage of abdominal fluid collection. The mean age of the patients in our study were  $55.5 \pm 10.9$  (SD), ranging from 29 to 84. Laparotomy or relaparotomy was planned due to clinical symptoms such as fever, abdominal pain, respiratory or intestinal problems, palpable mass, and CT or sonographic visualization of the fluid collection.

Seventy-five patients (86.2%) underwent recent abdominal surgery: of those, biliary surgery was performed in 33, gastrointestinal in 19, splenectomy in 10, liver surgery in 6, and other in 7 patients. The postoperative

sonography within the first 10 days detected intraperitoneal collection. In other 12 patients (13.8%) without previous laparotomy intraperitoneal or retroperitoneal fluid collection was found by ultrasound or computed tomography. In this group we detected paracolic abscesses due to diverticulitis in 6 patients, and retrocecal appendicitis in one patient. The retroperitoneal penetration of the descending colon carcinoma caused a huge abscess formation with compression to the bowel in one patient. Two collections appeared liquefied neoplasms; one was induced by the gastric ulcer perforation and the other by the missile penetration.

All percutaneous drainages were performed under the sonographic guidance. All specimens obtained by needle aspiration were submitted for cytology, aerobic and anaerobic cultures. Nonpurulent materials were also chemically analysed. Eight to 14 French catheters were used to evacuate abdominal collections. Generally, we used 8 to 10 French catheters for serous collections including bile, and for intercostal approach. Twelve to 14 French catheters were used for purulent and viscous collections. The complete procedures consumed 10 to 30 minutes of time, depending mostly on localization. Patients were regularly followed-up the 2nd and 7th day from percutaneous catheter placement, as well as immediately after the drainage stopped. The catheter was not removed before sonography or CT confirmed the complete evacuation of the infected collection. Incomplete drainage was tolerated in particular sterile hematomas if evacuation stopped and clinical response was favorable. In other noninfected collections we also insisted on complete evacuation before the catheter removal. In a case of catheter malfunction or absence of clinical improvement, the catheter position and function were revised with sonographically controlled instillation of 5-10 ccm of normal saline.

We used intercostal, subcostal, lateral, and

anterior approach with the patient supine, in the left or right decubitus position. The access route was elected by the previous sonographic examination. Intercostal drainage was performed as lower as possible to reach the collection, at least 2 intercostal spaces lower than the dome of the diaphragm was visualized. If the puncture line included pleural effusion, the catheter was not applied.

The linear array transducers of 5 MHz with the central canal to guide the needle were used in our series. The needle position was constantly monitored during the insertion, diagnostic aspiration and the guide wire placement if the Seldinger technique was used. We also used a trocar technique, especially in the intercostal approach. When properly positioned, catheters were secured in place by suturing to the skin.

Statistical differences were calculated with the Mann-Whitney U (MWU) test, and the analysis of variance (ANOVA).

The procedures were conducted in accordance with the ethical standards of the Helsinki Declaration of 1975.

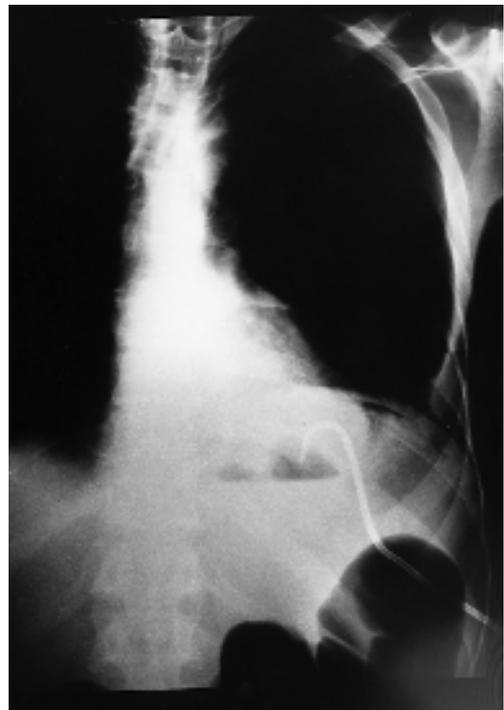
## Results

In five-years' period we performed 89 percutaneous catheter drainages of abdominal fluid collections in 87 patients under the sonographic guidance.

We detected 34 fluid collections (38.2%) in the right subphrenic space with or without subhepatic extension, 8 collections (9.0%) isolated in the subhepatic space, 17 collections (19.1%) in the left subphrenic space, 11 collections (12.4%) between the intestinal loops, 10 collections (11.2%) in the right/left paracolic gutter, and 6 collections (6.7%) in the retroperitoneum. Other rare locations included preperitoneal collections beneath the abdominal wall in 2 cases, and lesser sac abscess in one patient. In two patients we drained 2 different collections consecutively.

Aspirated material was macroscopically purulent in 31, sanguineous in 11, serous in 9, and undetermined in 21 collections. In 17 collections we aspirated bile. A Gram stain, aerobic and anaerobic cultures confirmed infected material in 47 (52.8%) specimens. Namely, 5 hematomas, one seroma, and 10 undetermined collections were infected. Fifty-eight specimens were submitted for a chemical analysis to confirm the origin of a fluid collection. Cytologic examination indicated malignant tumor in four specimens.

Of 51 subphrenic collections, intercostal approach was used to drain 31 (60.8%) collections, 20 out of 34 (58.8%) in the right and 11 out of 17 (64.7%) in the left subphrenic space. We selected intercostal approach (Figure 1) whenever it was the shortest route to reach the collection, but only if pleural effusion could be avoided on the puncture line. In 20



**Figure 1.** Intercostal approach to drain left subphrenic abscess formation. Note elevation of the left hemidiaphragm, and gas accumulation below.

(39.2%) subphrenic collections the extrapleural access route was preferred.

We preferred the lateral approach for percutaneous drainage of the collections in paracolic gutters, the posterolateral approach for the retroperitoneal collections, and the anterior approach for preperitoneal and lesser sac collections. The access route for the collections between the intestinal loops was selected individually to avoid small or large bowel transgression. Intestinal interposition was excluded by the real-time sonographic monitoring of peristalsis.

The median number of days of drainage for all abdominal collections was 13 days (range, 2-73 days). Significant variability regarding the duration of drainage of different fluid qualities was detected (Figure 2, ANOVA). The median drainage time for purulent collections was 18 days (range, 7-73 days), significantly longer ( $p < 0.05$ , MWU) in comparison to hematomas (median, 11 days; range, 5-28 days). The drainage time for bilomas (median, 6 days; range, 2-17 days), seromas and other nonpurulent collections (median, 6 days; range, 3-13 days) was significantly

shorter ( $p < 0.05$ , MWU) compared to hematomas, and purulent collections. Patients stayed in hospital up to 20 days after the catheter insertion. If the drainage had to be prolonged (Figure 2), the outpatient care with regular weekly controls was preferred.

Although 8 and 10 French catheters were used in the intercostal approach, the mean duration of drainage was not significantly different in comparison to the subcostal drainage route where larger catheters (up to 14 French) were placed (median, 15 and 12 days, respectively).

Intra-abdominal collections were completely evacuated in 76 (87.4%) patients, including both patients with two different collections in the abdomen. In 4 (4.6%) patients with sterile hematoma evacuation was incomplete, but percutaneous drainage was a definitive method. Further resolution of residual coagulated blood products after the catheter removal was followed-up on ultrasound controls until the resorption is completed (up to 95 days). Sonographically guided percutaneous drainage was entirely successful in 80 patients (92%) with 82 collections. Forty-nine

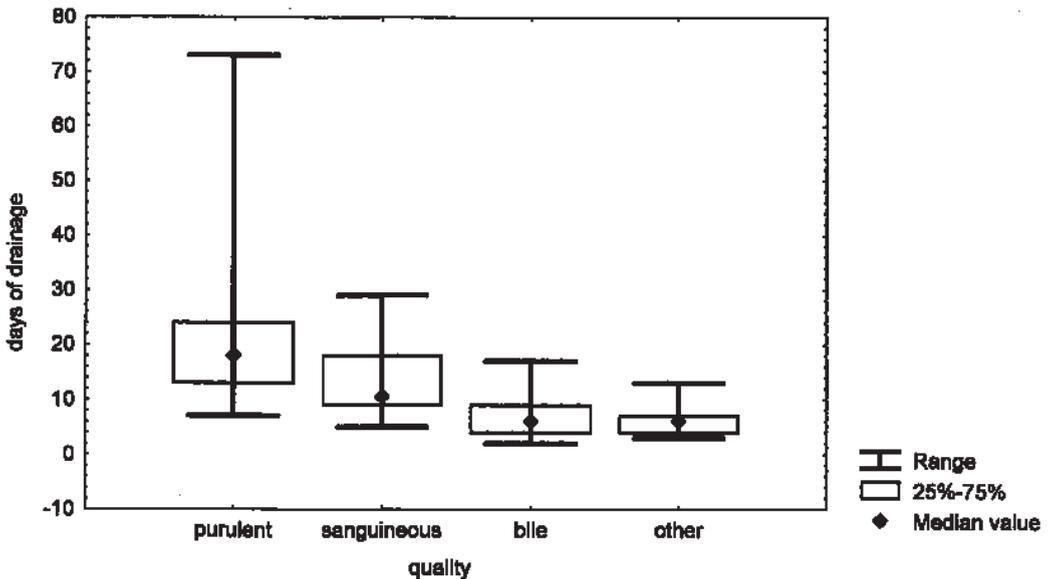


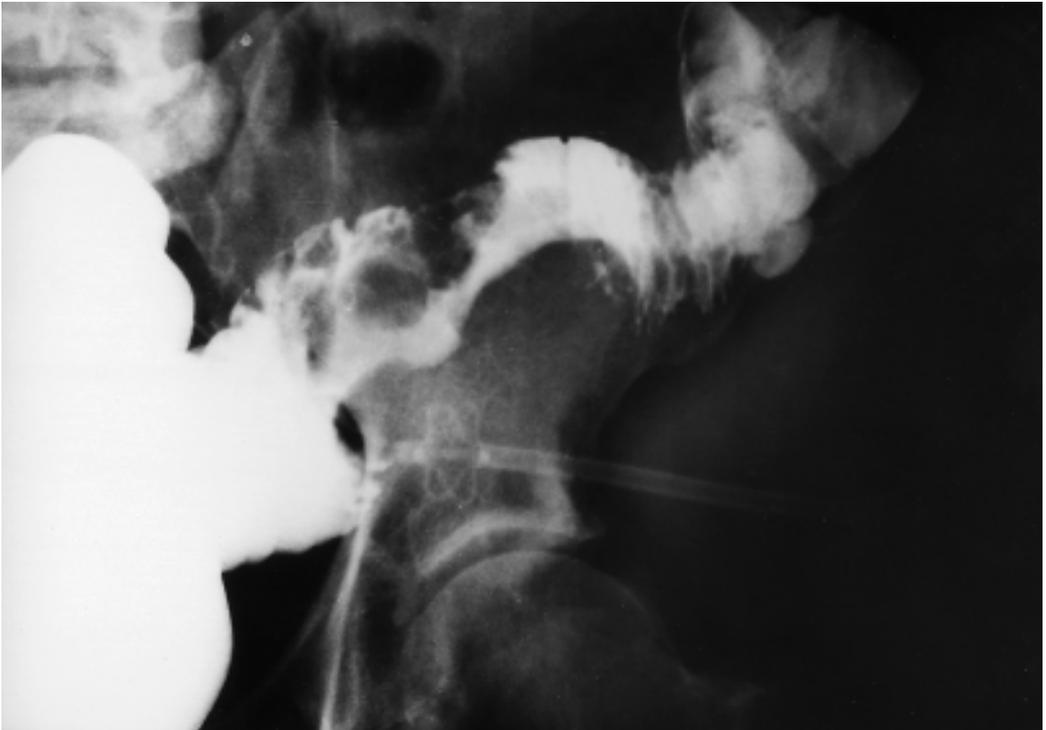
Figure 2. Drainage time variability for different qualities of abdominal collections.

of 51 patients with subphrenic collections (96%) were cured by percutaneous catheter drainage.

Only in four patients the surgical procedure was necessary, but even those patients benefited from the percutaneous drainage. Namely, body temperature and white blood cell count decreased, while the overall condition improved. In the first patient with the complete bowel obstruction due to the huge extraluminal abscess formation and compression we evacuated 900 ccm of purulent and necrotic material. This procedure facilitated the normal evacuation of the colon, and a patient became fit for surgery. Carcinoma of the descendent colon penetrating to the retroperitoneal space was diagnosed with the barium enema after the percutaneous drainage (Figure 3). Right subphrenic collection in the second patient was a result of an

intestinal perforation due to carcinomatous peritoneal dissemination, and percutaneous drainage preceded the operative resection. In both cases previously existed ileus subsided. Continuous daily drainage of 500-700 ccm of bile in the third patient indicated postoperative biliary fistula that required a surgical revision. Retrocecal abscess due to perforated appendicitis in the fourth patient was drained, and appendectomy followed.

In another two patients abdominal collections appeared liquefied neoplasms on cytology, and percutaneous drainage was only a palliative procedure with the evident clinical improvement. Finally, one patient with hematemesis died the 3rd day after the catheter placement. The abscess adjacent to the left hepatic lobe was diagnosed on CT and US, and sonographically guided percutaneous drainage without hepatic transgression fol-



**Figure 3.** Percutaneous drainage of the retroperitoneal collection due to colon carcinoma invasion. Note irregular segmental stenosis of the colon. Catheter was introduced above the inguinal ligament to the left iliac fossa.

lowed. We evacuated 600 ccm of purulent material. At autopsy, a bleeding gastric ulcer with localized perforation was detected. The abscess cavity was localized to the lesser sac, and a catheter was placed in the proper position.

We detected 8 (9.2%) minor complications in our series, including superficial skin infection in one case, chills immediately after the catheter placement due to bacteremia in 2 patients, and intestinal content leakage near the subcostally introduced catheter in one patient with intestinal fistula. In one patient left subphrenic abscess after splenectomy recurred, and percutaneous drainage had to be performed again. The second attempt was followed by complete resolution of the fluid collection.

In two patients with intercostal approach concomitant pleural effusion increased in size, without clinical impairment. Aspirated pleural fluid was sterile. Only in one patient asymptomatic pneumothorax was detected after the intercostal catheter insertion.

Life-threatening complications of the sonographically guided PAD were not detected in our patients.

## Discussion

In our series 80 out of 87 patients with abdominal fluid collections were cured by percutaneous drainage. Even 96% of all subphrenic collections were cured without further surgical intervention. Complications of the percutaneous catheter drainage of abdominal collections at surgery department in our patients were minor, incomparable with the reported morbidity and mortality rate (19.4% and 4.8%, respectively) of the surgical drainage of subphrenic abscesses.<sup>6</sup>

High successful and low complication rate in comparison to the previous reports<sup>2,5</sup> could be explained by the following: (1) five patients with the incomplete evacuation of the

sterile hematoma who did not need further intervention were included in the success group (2) in three patients we canceled the procedure due to the equivocal bowel interposition (3) in 6 patients where needle insertion through the pleural effusion was unavoidable, we elected percutaneous aspiration of the subphrenic collection and instillation of antibiotics if the material was purulent. Percutaneous aspiration was repeated in 2 patients with the reaccumulation of the fluid content. Sonographic guidance provided a reliable differentiation between subphrenic and pleural accumulation due to the multiplanar imaging and real-time monitoring of diaphragmatic movement.

According to McNicholas et al. subcostal (extrapleural) drainage of subphrenic collections could be difficult only on the left side, especially after splenectomy.<sup>7</sup> In our experience this problem appears on both right and left side. Namely, subphrenic inflammation usually causes the ipsilateral diaphragmatic relaxation and diminishes its respiratory movement. Therefore, liver and spleen are withdrawn from the costal arch, and the inspiration is frequently not very helpful in subcostal approach. Although McNicholas et al. consider right-sided subphrenic collections easier to drain subcostally, liver parenchyma was frequently interposed and unavoidable in subcostal approach in our patients, especially if subphrenic collection did not extend to the Morrison's pouch. We elected the intercostal approach whenever the collection could be reached avoiding pleural effusion, if it was the shortest drainage route.

In our experience, definitive diagnosis did not need to be established before the percutaneous puncture of an abdominal fluid collection visualized on CT or sonography. The initial aspiration confirms the presence of a collection, determines whether the collection is infected and the material liquefied enough to be drainable, and establishes a safe route for the subsequent catheter insertion.<sup>4</sup> We di-

agnosed diverticulitis, large bowel carcinoma and retrocecal appendicitis on barium studies after the drainage was completed.

According to our results, the drainage time for hematomas was significantly longer than for bilomas and other nonpurulent collections, and in this group we had 4 incomplete evacuations. One could speculate if catheter drainage of hematomas is really justifiable, or needle aspiration should be sufficient. We recommend the catheter placement when a symptomatic collection is visualized even if sanguineous content is aspirated. Namely, five out of 11 hematomas in our series were infected, and even patients with sterile hematomas benefited from the procedure. Small, asymptomatic early postoperative collections are probably seromas or hematomas, requiring only ultrasound follow-up.

Conclusively, sonographically guided percutaneous drainage is the method of choice for the treatment of symptomatic postoperative abdominal fluid collections. This method is also successful in nonoperative treatment of abdominal collections that otherwise requires explorative laparotomy. In our experience, it was a definitive method in the treatment of the perforative diverticulitis. If the puncture site is at least two intercostal spaces lower than the dome of diaphragm and a catheter is not placed through pleural effusion, the intercostal drainage route for subphrenic collections is not less secure than the subcostal approach. If pleural effusion is unavoidable, only percutaneous puncture and aspiration without the catheter placement should be performed.

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