Predicting Factors for Failure of Percutaneous Drainage of Postoperative Intra-Abdominal Collection

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Objective: *To determine the predictive factors for failure of percutaneous drainage (PD) of postoperative intra-abdominal collection, to better select the patients who might benefit from PD.*

Material and Method: *From September 2011 to February 2013, the authors reviewed 42 patients with symptomatic post-operative intra-abdominal collection who had received PD at Ramathibodi Hospital. The PD was considered as failure when clinical sepsis persisted or subsequent surgery was needed. Univariate analysis was used to examine the relationships between failure of PD and the collection and drainage-related variables.*

Results: *The success rate of PD in the present study was 80%. No major complication was detected. The overall mortality was 12%. Univariate analysis showed that the presence of biliary fistula (p = 0.012), subhepatic location (p = 0.040) and the drainage catheter size of 12F (p = 0.002) were significant predictive variables for failure of PD.*

Conclusion: *Image-guided PD of postoperative intra-abdominal collection was found to be a safe and effective procedure with few complications. Initial recognition of biliary fistula in the collection at subhepatic region or in patients underwent hepatobiliary surgery was the important prognostic factor for unsuccessful PD. These patients may be more beneficial for initial surgical drainage.*

Keywords: *Percutaneous drainage, post-operative intra-abdominal collection, predicting factors*

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Intra-abdominal collection remains a frequent cause of morbidity and mortality following abdominal surgery. Early recognition and appropriate drainage are essential factors for intra-abdominal collection to be treated successfully. During the past three decades, the state of the art in image-guided percutaneous drainage (PD) has become a safe and effective alternative to surgical drainage (SD)[1-7]. Despite the lack of randomized study comparing percutaneous to surgical drainage of postoperative collection in abdomen, PD has become a widely accepted treatment for accessible postoperative intra-abdominal collection[8-11]. With improvement of drainage technique and radiological experience, PD of complex collections including loculated collection, collection communicating with enteric or biliary fistulas and multiple collections is commonly performed. However, there is no definite consensus regarding the use of PD as the initial treatment. We performed this retrospective study to determine the successfulness of this treatment option and to identify the predictive factors of PD failure in postoperative intra-abdominal collection to improve the selection of proper subjects with postoperative intra-abdominal collection who might benefit from initial treatment with PD rather than initial open drainage.

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Material and Method

Patients

The study was approved by the Institutional Review Board, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, study protocol number ID 08-56-48. From September 2011 to February 2013, we identified 42 patients with symptomatic postoperative intra-abdominal collection who had received PD at Ramathibodi Hospital. All collections were diagnosed by ultrasonography (US) and/or CT scan. The patients with intra-abdominal collection who had combined therapy other than PD such as adjunctive use of fibrinolytic agents instilled via the drainage catheter are not included in the present study. Two patients were excluded from the study due to loss follow-up evaluation and denial of further treatment. Only 40 patients with 45 collections were included in the present study. The study group comprised 17 men and 23 women, with a mean age of 52±18 years (range 3 to 83 years). The primary diseases of patients and different types of initial surgical procedure were summarized in Table 1 and 2, respectively.

A simple collection was defined as a single unilocular cavity without evidence of an enteric connection. The collections were defined as complex when demonstrated either a multilocular cavity or when communicated with fistulae. According to the definitions, the collections were classified as simple in 22 patients (55%) and complex in 18 patients (45%). Eight collections connecting with fistulous tracts were observed; biliary fistula in 3 cases, pancreatic fistula in 2 cases, and an enteric fistula in 3 cases. The mean size of collections was 9.5±3.6 cm (range 3 to 18 cm).

Percutaneous drainage procedure

All the procedures were performed under local anesthesia with/without intravenous sedation/analgesia and image guidance. The PD procedures were done by one of five attending staffs in our unit who has practice experience in this field for 4 to 7 years or fellows under close supervision of the staff. The majority of the cases (33 patients) used combined ultrasound and fluoroscopic-guided procedure. The interventionists also used ultrasound guidance in 4 patients, CT guidance in 2 patients, and combined fluoroscopy/ultrasound/CTguidance in one patient. Diagnostic fluid aspiration was initially performed in most cases for gross evaluation and sent for further investigation according to clinician's request. Large drainage catheter caliber was chosen when viscous material was encountered. The pigtail drainage catheter size ranged from 8 to 12 French (F) (Skater Drainage Catheter, Angiotech, Stenlose, Denmark; Neo-Hydro Multi-purpose Drainage Catheter, UK Medical, Sheffield, United Kingdom; Cook-Cope Loop Catheter, Cook Medical, Indiana, United State) was placed in the collection using the modified-Seldinger technique or Trocar method. Different routes of drainage approach were selected depending on location of the collections; transabdominal approach in 40 collections, transhepatic approach in 2 collections, transgluteal approach in 2 collections, and translumbar approach in one collection. Collecting bags were attached for gravity drainage after placing a stopcock at the external end of the catheter. The catheters were irrigated with 5 ml sterile saline one to three times per day to prevent catheter blockage depending on viscosity of the collection.

Table 1. Underlying primary disease

	Total n = 40 n (%)
Intra-abdominal malignancy	19 (48)
Intra-abdominal benign tumor	3 (7)
Infection/inflammatory disease	11 (28)
Miscellaneous	7 (17)
ESRD awaiting for kidney transplantation	5
Ruptured abdominal aortic aneurysm	1
Biliary atresia	1

Table 2. Type of initial surgical procedure

	Total n = 40 n (%)
Colorectal surgery	12 (30)
Right colonic resection	2
Sigmoidectomy	1
Total colonic resection	1
Hartman's procedure	1
Low anterior resection	3
Abdominoperineal resection	1
Colonic detorsion with colostomy	1
Appendectomy	2
Hepatic and biliary surgery	8 (20)
Hepatic resection	2
Laparoscopic cholecystectomy	2
Open cholecystectomy	2
Liver transplantation	2
Pancreatic and splenic surgery	5 (12.5)
Pancreaticoduodenectomy	3
Pancreatectomy and splenectomy	1
Pancreatic tumor enucleation	1
Pelvic surgery	5 (12.5)
Total hysterectomy	1
Total hysterectomy with bilateral salpingo-oophorectomy	2
Total hysterectomy with pelvic lymph node resection	1
Prostatectomy	1
Kidney transplantation	5 (12.5)
Gastric surgery	2 (5)
Total gastrectomy	1
Partial gastrectomy	1
Retroperitoneal tumor resection	2 (5)
Aortic aneurysmorrhaphy	1 (2.5)

Decision for giving concomitant antibiotics was based on the judgment of the referring physician. Antibiotics were initially chosen empirically and changed, if necessary, based on culture and sensitivity results.

The catheter could be removed upon improvement of clinical findings, recording less than 10 ml of drainage per 24 hours of two or three consecutive days, and complete or near-complete resolution of the collection in follow-up ultrasonography and/or CT scan. Before catheter removal, it was made sure that cessation of drainage was not due to catheter blockage. Sudden decreased amount or ceased over a 24-hour period of drainage content should raise the suspicion of catheter obstruction or kinking, whereas sudden increased/persisted high amount of drainage content should signal to find out fistulous communications. Patients were divided into two groups based on successfulness of PD. The PD was considered to be successful if the patient's intra-abdominal infection resolved without the need for additional surgery. Failure drainage was considered in case of persisting clinical sepsis and when surgery or other interventional procedure beside the PD was needed.

The complications following PD were classified as minor and major complications according to SIR standards of practice committee classification of complication by outcome[12]. A major bleeding complication was defined as meeting or exceeding grade 3 complication as defined by the National Institutes of Health's Common Terminology Criteria for Adverse Events (CTCAE), version 3.0[13]. Specifically, a grade 3 hemorrhage includes an event for which a transfusion, an interventional radiology procedure, or an operative intervention is indicated. Isolated hospitalization is not included.

Statistical analysis

Quantitative data were expressed as mean± SD (range) or median and range based on data distribution. Univariate analysis was used to examine the relationships between failure of PD and the 27 following variables: abscess characteristics included number, size, complexity, associated fistula, localization, type of aspirated content, and type and number of organisms cultured, route of drainage, size of drainage catheter, and procedure time. Comparison between the success group and the failure group was analyzed by the Chi-square test, using SPSS 11.5 software (SPSS Inc., Chicago, IL, USA). Statistically significance was defined as $p<0.05$.

Results

Percutaneous catheter drainage was technically success in all 40 patients in the present study. Aspirated contents were clear fluid in 18 collections (40%), purulent content in 16 collections (35%), and serosanguineous or old blood in 11 collections (25%). Microbiologic culture showed no identified organism in 19 collections (42%), multiple bacterial organisms in 11 collections (24%), single bacterial organism in 9 collections (20%), fungi in 3 collections (7%), and no available data in 3 collections (7%).

Two patients required repeated drainage due to recurrent collection. The drainage catheter was changed to larger caliber and repositioned to allow sufficient drainage in one patient. The failure group consisted of two patients who underwent further surgical drainage (one repaired dehiscence of colic anastomosis and the other salvage drainage of pancreatic necrosis), three patients who underwent further ERCP with plastic biliary stent for biliary fistulae, and three patients died without further surgical drainage.

The median duration of catheter placement in the success group was 12.5 days (range 3 to 123 days). In the success group, drains were left in place for a median of 9 days (range from 5 to 39 days) for patients without communicating fistula and significant longer for a median of 85 days (range 31 to 123 days) in patients with fistula ($p<0.001$). All enteric and biliary fistulae were confirmed by fluoroscopy during PD. Pancreatic fistulae were suggested when high levels of lipase and amylase in the content were obtained from the collection. After surgical drainage in the failure group, no re-accumulated collection required PD.

The overall mortality rate was 12% (5 patients). Two patients died of multiple system organ failure after successful PD and CT scan provided evidence of complete collapse of abscess cavity. Three patients in the failure group also died of multiple system organ failure with no salvage surgical drainage of intra-abdominal collection.

Complication related to PD was observed in one patient in the success group. This patient had small subcutaneous abscess at insertion site after removal of drainage catheter which resolved after medical treatment. No major complication related to PD was found in the present study.

Univariate analysis showed three variables associated with an increased risk of PD failure (Table 3): presence of biliary fistula ($p = 0.012$), subhepatic location ($p = 0.040$) and the drainage catheter size of 12F ($p = 0.002$). The collection located in pelvic cavity was the only one variable associated with decreased risk of PD failure using univariate analysis ($p = 0.012$).

Discussion

During postoperative period, ultrasonography and CT scan allow an early diagnosis of fluid collection which potentially needs drainage. During the last three decades, the image guidance PD was extensively used and established as an effective method for treatment of post-operative intra-abdominal collection/abscess when an accessible route is available[1,6,9]. Several authors consider that abscess can benefit from PD only in selected cases. The prior few studies have identified the factors predictive of the failure of PD[14,15], including enteric fistula, multiple or loculated abscesses, large

Table 3. Univariate analysis of factors related to failure of percutaneous drainage of 45 postoperative intra-abdominal collections

	Success group (n = 34)	Failure group* (n = 11)	*p*-value**
Procedure time (min)	25±13	26±10	0.720
Size of collection (cm)	9.3±3.4	10.4±4.3	0.358
Multilocular collection	13 (76)	4 (24)	1.000
Presence of fistula			
Small bowel	1 (100)	0 (0)	1.000
Colon	1 (50)	1 (50)	0.433
Bile duct	0 (0)	3 (100)	0.012**
Pancreas	2 (100)	0 (0)	1.000
Location of collection			
Subphrenic	9 (82)	2 (18)	0.705
Subhepatic	1 (25)	3 (75)	0.040**
Paracolic gutter	4 (57)	3 (43)	0.337
Pelvic cavity	19 (95)	1 (5)	0.012**
Pancreatic lesser sac	1 (100)	0 (0)	1.000
Pararenal	0 (0)	2 (100)	0.056
Type of aspirated content			
Clear fluid	14 (78)	4 (22)	1.000
Pus/turbid fluid	9 (69)	4 (31)	0.704
Hematoma	11 (78)	3 (22)	1.000
Route of drainage			
Transabdominal	32 (80)	8 (20)	0.085
Transhepatic	0 (0)	2 (100)	0.056
Transgluteal	2 (100)	0 (0)	1.000
Translumbar	0 (0)	1 (100)	0.244
Size of drainage catheter			
8F	15 (79)	4 (21)	0.736
10F	19 (86)	3 (14)	0.165
12F	0 (0)	4 (100)	0.002**
Cultured organism			
Single organism	6 (86)	1 (14)	0.663
Mixed organisms	8 (67)	4 (33)	0.448
Fungi	2 (67)	1 (33)	1.000
No growth	16 (80)	4 (20)	0.730
Non-available	2 (67)	1 (33)	1.000

* Values in parentheses are percentages
** Statistically Significant ($p<0.05$)

abscesses, necrotic tissue, and pancreatic location.

In the present study, the clinical success rate of PD for treatment of postoperative intra-abdominal collection was 80%. Our success rate compared favorably with those reported by others, ranging from 43% to 80%[11,14]. Benoist et al[14] examined the factors predictive of PD failure for postoperative intra-abdominal abscesses in 73 patients and found that an abscess diameter of less than 5 cm and the absence of antibiotic therapy were the only two independent factors associated with failure of PD. Their study showed that even complex postoperative abscesses,

such as those associated with enteric fistulae, were not associated with failure. In that study, patients with small abscesses in the failure group required repeat surgery for persistent or recurrent sepsis after drainage catheter removal, probably because of incomplete drainage. In the present study, when abscess drainage was insufficient, the catheter was changed for a larger one or revised to proper position that allowed sufficient drainage. This adaptable drainage technique may have been an important factor in improving the outcome[15,16].

The univariate analysis in the present study showed that only three factors related to increase risk for failure of PD including: presence of biliary fistula, subhepatic location of the collection and the use of 12F drainage catheter. However, all subhepatic collections and a half of collections (2 of 4 collections) which drained by 12F catheter in the failure group were those patients having collection with biliary fistula. None of collection with biliary fistula was successfully drained with PD alone in the present study. All patients with biliary fistula underwent further ERCP with biliary stent placement, even though the drainage catheters were still left in the collection until the collections were completely resolved. Besides that, there was no significant correlation between the presence of fistula to small bowel and colon and the failure of PD in our observation. Some hypotheses may be raised to explain our result. First, the volume of daily bile secretion may be large volume and PD alone could not be sufficient drainage. Second, the presence of bile acid did not promote the healing process of the fistulous tract. These hypotheses are further supported by the fact that there was complete resolution of all collections in patients with biliary fistula who underwent ERCP with biliary stent placement to divert of bile flow into duodenum and no recurrent of the collection after removal of PD catheter.

One unsuccessful case of PD insertion with 12F catheter had three large intra-abdominal collections with thick pus content. This patient died a month following PD from multiple system organ failure without salvage open drainage. The other case in failure group using 12F catheter was found pancreatic necrosis after undergoing surgical drainage and complete resolving of the collection.The authors considered usage of the large caliber catheter in the collection with high viscosity content and this may explain the tendency of insufficient PD.

Mortality and morbidity rates are two important issues to be considered before determining the best therapeutic option for treatment of postoperative intra-abdominal collection. In the present study, overall mortality rate was 12%, which is similar to the rate usually reported, ranging from 0% to 16%[14,16,17]. The authors found that all of the death cases were not directly associated with PD procedure, but possibly related to inadequate collection drainage. However, the big differences in mortality rate is also possible from the variable of underlying disease and initial surgical treatment in different studies.

The rate of procedural related complication was very low in the present study as compared to the prior reported study.We found only one case of minor complication from all 40 patients. This patient had small subcutaneous abscess at insertion site after removal of drainage catheter which resolving after medical treatment. No major complication was found in the present study.

The potential limitations of the present study included a retrospective design with heterogeneous study population because of the wide variations in the underlying disease and operative procedures. The decision of whether to undergo PD was at the discretion of the surgeon, which could have resulted in selection bias. However, the data showed some statistically significant factors which might have clinically significant implication about predicting failure PD.

Further studies are needed to evaluate the effectiveness and impact of clinical outcome in the specific patient groups.

Conclusion

Image-guided PD of postoperative intra-abdominal collection was found as a safe and effective procedure with few complications. It should be first considered despite the presence of multiloculated collection, multiple collections, or intestinal fistula. However, initial recognition of biliary fistula in the collection at subhepatic region in patients underwent hepatobiliary surgery was the important prognostic factor for unsuccessful PD. The initial use of 12F drainage catheter which related with markedly high viscosity of the collection was also found significant with PD failure. These patients may be more beneficial for initial surgical drainage rather than percutaneous drainage.

What is already known on this topic?

The current data revealed that PD is an effective management option in patients with intra-abdominal collections. Unfortunately, there is no well-established data about factors predicting failure after the procedure, particularly in post-operative patients. In addition, there is little data on the effectiveness of this treatment option in Thailand.

What is this study adds?

The present study confirmed the effectiveness of PD for treatment of fluid collections following intra-abdominal surgery.The authors also found that the presence of some factors may significantly increase the risk of PD failure, including biliary fistula, subhepatic location and initial use of drainage catheter size (12F) which related to high viscosity of the collection. The present data implied that these patients may be more beneficial for initial surgical drainage rather than percutaneous drainage.

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Potential conflicts of interest

None.

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ปัจจัยที่ช่วยทำนายความล้มเหลวของการใส่สายระบายของเหลวที่คั่งค้างในช่องท้องที่เกิดตามหลังการผ่าตัด

ชินรัตน์ บัวงาม, พันเลิศ แววศักดิ์, บรรจงศักดิ์ เวชศาสตร์, ธรินทร ตรีสิทธิ์, อรพิณ ชาญสันติ, ธนพงศ์ พันธุ์พิกุล, เจียมจิตร ตปนียากร

วัตถุประสงค์: *ศึกษาปัจจัยที่จะช่วยทำนายว่าผู้ป่วยที่มีของเหลวที่คั่งค้างในช่องท้องภายหลังการผ่าตัดกลุ่มใดมีโอกาสที่จะไม่ตอบสนองต่อการรักษาด้วยการใส่สายระบายผ่านทางหน้าท้อง เพื่อจะได้ลดความล่าช้าในการพิจารณารักษาด้วยการผ่าตัดเข้าไประบายของเหลวที่คั่งค้างดังกล่าว*

วัสดุและวิธีการ: *ศึกษาเวชระเบียนและภาพรังสีวิทยาย้อนหลังในผู้ป่วยที่มีของเหลวที่คั่งค้างที่เกิดตามหลังการผ่าตัดในช่องท้องซึ่งผ่านการใส่สายระบายผ่านทางผิวหนัง ตั้งแต่เดือนกันยายน พ.ศ. 2554 ถึงเดือนกุมภาพันธ์ พ.ศ. 2556*

ผลการศึกษา: *ผู้ป่วยที่มีของเหลวคั่งค้างในช่องท้องส่วนใหญ่ประสบความสำเร็จหลังรักษาด้วยการใส่สายระบายผ่านทางผิวหนังโดยไม่พบภาวะแทรกซ้อนที่รุนแรง อย่างไรก็ตามการที่พบรูติดต่อระหว่างท่อทางเดินน้ำดีกับของเหลวที่คั่งค้าง, ตำแหน่งของเหลวที่คั่งค้างบริเวณใต้ตับ, และความจำเป็นต้องใช้สายระบายขนาดใหญ่ (12F) เพื่อระบายของเหลวที่มีความข้นหนืดมากตั้งแต่เริ่มต้นเป็นปัจจัยที่ช่วยทำนายว่าการรักษาด้วยการใส่สายระบายทางผิวหนังอาจไม่ได้ผล*

สรุป: *การใส่สายระบายผ่านทางหน้าท้องเพื่อรักษาภาวะของเหลวที่คั่งค้างในช่องท้องที่เกิดตามหลังการผ่าตัดเป็นวิธีที่มีประสิทธิภาพและปลอดภัย อย่างไรก็ตามผู้ป่วยที่มีปัจจัยบางอย่างอาจไม่ประสบความสำเร็จด้วยวิธีการรักษาดังกล่าว ผู้ป่วยกลุ่มนี้จึงไม่ควรล่าช้าในการที่จะพิจารณารักษาด้วยการผ่าตัดซ้ำเพื่อเปิดล้างของเหลวที่คั่งค้าง*
