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Research Article

Image Guided Percutaneous Drainage of Intra-Abdominal Collections

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ABSTRACT

Background: Intra-abdominal collections and abscesses are commonly encountered in surgical practice. They contribute to significant morbidity and mortality, hence, need to be addressed expeditiously. Percutaneous catheter drainage (PCD) is an important treatment modality that is now in vogue.

Aim: This study was carried out to assess the outcomes of image guided PCD of intra-abdominal collections/ abscesses.

Materials and Methods: This prospective study was carried out at a tertiary centre on patients who underwent image guided drainage of intra-abdominal collections/ abscesses from Jul 2014 to Dec 2016. Data was collected by following up the patients both clinically and radiologically.

Results: 31 patients underwent PCD. Procedure was successful in 77.4%. Complete resolution was observed in all post-operative collections. Collections resolved after a single drainage procedure in 71% while the remaining 29% required multiple drainage procedures. Liver abscesses were the commonest, with multiple foci. Organisms were isolated in 13%, Escherichia coli being the commonest isolate. Higher leucocyte counts, lower levels of drain amylase and shorter duration of antibiotics were significantly associated with the success of the procedure. There were no complications other than an isolated case of biliary fistula following drainage of liver abscess. Ultrasonography was found to be at par with CT scan for PCD.

Conclusion: Image guided PCD is a safe and efficacious procedure for the treatment of intra-abdominal collections and abscesses. It has a high success rate, especially in postoperative collections. The procedure has low morbidity and low complication rates. High leucocyte count, short duration of antibiotic exposure and low levels of drain fluid amylase are independent predictors of favourable outcome after percutaneous drainage.

Introduction

Intra-abdominal collections and abscesses are well-defined accumulations of sterile fluid and infected material, respectively. They are commonly encountered in clinical practice and cause significant morbidity and mortality. Diagnostic modalities that are commonly employed to detect them are ultrasonography, Computerized Tomography (CT), Magnetic Resonance Imaging (MRI) and nuclear scintigraphy [1-4]. In addition to apt anti-microbial therapy and source control, prompt drainage plays a pivotal role in their management [5]. Real time imaging facilitates percutaneous catheter drainage (PCD) of abdominal collections by precise guidance, without collateral damage to vital structures. The efficacy of PCD has enabled its emergence as a safe

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and effective alternative to open drainage, whilst being minimally invasive [1, 2]. Hence, it is now considered the primary and preferred modality of management, even in those collections that were earlier considered drained best by laparotomy [3, 4]. The present study aims to assess the factors which could influence the success and failure of image guided percutaneous drainage of intra-abdominal collections.

Materials and Methods

Following clearance by the institute ethical committee, this prospective study was carried out on patients who underwent drainage for intra-abdominal collections at a tertiary care teaching hospital, in Western India, from Jul 2014 to Dec 2016. The decision for pigtail drainage was taken jointly by the treating surgeon and intervention radiologist. Informed written consent was obtained from all the patients before the procedure. Patients with generalized peritonitis, those without a safe window for drainage and those unwilling for the procedure were excluded from the study.

I Definitions

The term intra-abdominal collection encompasses the following: intra-abdominal abscess, abscess localized to solid abdominal viscera, pancreatic/ peri-pancreatic necrotic/ fluid collections, and post-operative collections in the abdominal cavity. A procedure was considered successful if resolution of the collection was complete after one or more image guided PCD procedure without the need for surgery. Resolution was considered complete when symptoms resolved and the abscess cavity disappeared, radiologically. A procedure was considered failed when surgical drainage was necessary for effective resolution despite PCD. The day of onset was defined as the day when patient became symptomatic with the collection/ abscess. Days taken for resolution were calculated from the day of PCD to the day of removal of the catheter. Additional drains were those catheters placed subsequently during the treatment period for promoting drainage. Procedures done within 24 hours of presentation to the hospital were considered as emergent procedures.

II Procedural Details

All procedures were performed in the intervention radiology suite/ CT scan centre. All procedures were done under local anaesthesia and with aseptic precautions. The collections were first confirmed by imaging (Figure 1) and guided aspiration using No 18 intravenous cannula. The aspirate was dispatched for gram staining, culture sensitivity and biochemical analysis. An appropriate sized pigtail catheter was selected by the attending interventional radiologist based on the nature of the initial aspirate and the size of the abscess. The pigtail catheter was placed using Seldinger technique (Figure 2), its position confirmed by aspiration of the contents (Figure 3) and imaging (Figure 4).

All the patients were followed up till discharge from the hospital and further on outpatient basis. Daily drain output was monitored and recorded. Patency of the drains was maintained by routine flushing with sterile saline to prevent clogging of the catheter by debris. Drain was removed under the following conditions: drain output less than 5 ml for three consecutive days; complete resolution of collections on imaging; failure of collections to resolve necessitating open drainage due to worsening of clinical condition; and in case of catheter related complications. The initial antibiotic therapy was empirical, guided by the location of the abscess, the general condition of the patient and the most commonly suspected pathogens. Later on, the antibiotics were switched according to the culture and sensitivity.

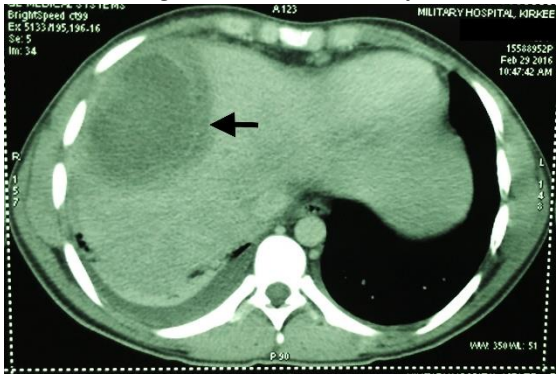

Figure 1: CT scan showing abscess in the right lobe of liver marked by a black arrow.

Figure 2: PCD performed using Seldinger technique.

Figure 3: Confirmation of the position of the catheter by aspiration.

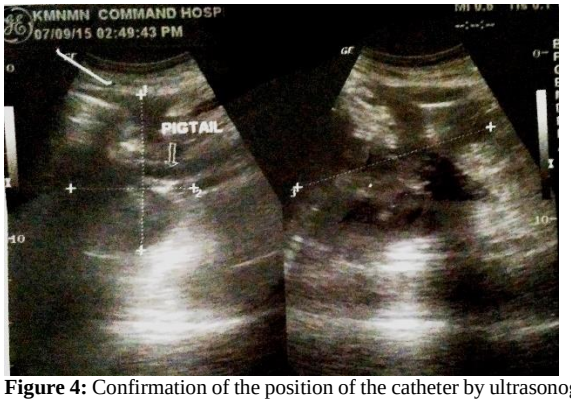

Figure 4: Confirmation of the position of the catheter by ultrasonogram.

III Statistical Analysis

The data was analyzed using Microsoft Excel & SPSS 21.0. Frequency and percentages for all categorical variables; mean and standard deviation for all continuous variables were measured and represented. Difference in proportions were tested using chi square test. Test for normality was carried out and Mann Whitney U test was applied to test for statistical difference in the mean between two groups. Pearson correlation coefficient was calculated to measure the strength of correlation between two continuous variables. A p value < 0.05 was considered statistically significant.

Results

The salient results are tabulated in (Table 1). The etiologies and locations of the collections are tabulated in (Table 2). The causative organisms, in decreasing order, are tabulated in (Table 3). Factors associated with the success or failure of the procedure are tabulated in (Table 4). The size of the collections ranged from 24 ml to 2775 ml with a mean size of 559±18.1 ml. Liver abscesses were the commonest, especially, with multiple foci. Escherichia coli was the most common organism isolated from the fluid collections.

Table 1: Distribution of study participants based on baseline characteristics (n=31).

	Frequency	Percentage
Age (in years)		
< 60	23	74.2
≥ 60	8	25.8
Gender		
Male	28	90.3
Female	3	9.7
Number of fluid collections		
Single	24	77.4
Multiple	7	22.6
Type of imaging used		
CT	16	51.6
USG	15	49.4
Catheter size used (in French)		
8	1	3.2
10	17	54.8
12	11	35.5
14	2	6.5
Number of drains required		
Single	7	22.6
Multiple	24	77.4
Type of procedure		
Emergency	4	12.9
Elective	27	87.1
Presence of growth in drain culture		
Present	9	12.9
Absent	22	87.1
Status of drainage		
Failure	7	22.6
Drained	24	77.4
Total	**31**	**100.0**

Table 2: Distribution of study participants based on characteristics of abscess and drains required (n=31).

Diagnosis	Location	Number of drains
Acute necrotising pancreatitis	Left paranephric space and paravertebral region	02
Liver abscess	Segments II,IV,VI,VII	03
Abdomino-pelvic abscess	Right paracolic region and pelvis	02
Liver abscess	Segment VI and VII	02
Ruptured splenic abscess	Anterior pole of spleen and perisplenic space	02
Ruptured liver abscess	Segment VII and V	02
Acute on chronic pancreatitis with pseudocyst	Intra and peripancreatic	02

Table 3: Distribution of study participants based on organisms detected in abscess drain.

Organism	Diagnosis
Escherichia coli	• Perisplenic abscess • Acute necrotising pancreatitis (operated) with resection of transverse colon • Splenic abscess • Abdominal abscess with no diagnosed primary pathology
Proteus	• Infected pancreatic pseudocyst
Klebsiella	• Liver abscess • Gall bladder perforation • Duodenal GIST (operated)
Citrobacter	• Acute necrotising pancreatitis

Catheterization was accomplished in all the patients, but resolution was successful only 77.1%. Single catheter drainage proved sufficient for 22 out of 31 patients while the remaining 9 (29%) required multiple drainage procedures. Post-operative collections, which accounted for 16%, showed complete resolution within a mean duration of 7.6 days. All failures were observed in collections due to other causes.

Higher rates of procedure failure was observed among elderly age group (37.5% vs 17.5%); female gender (33.3% vs 21.4%); CT scan as an imaging technique (37.5% vs 6.7%); however, these differences were not statistically significant. Of the 24 cases which were successfully drained, the minimum time taken for the resolution was 2 days and maximum time taken was 28 days with a mean of 8.4 $\pm$ 6.73 days. Higher leucocyte counts, lower levels of drain amylase and shorter duration of antibiotics were found to be significantly associated with the success of PCD. A significant positive correlation was observed between the time taken for resolution and size of the fluid collection (Pearson r =0.571, p value -0.004); and daily drain output (Pearson r = 0.512, p value -0.010) (Table 5). There were no significant complications other than development of biliary fistula in a patient following drainage of segment IV liver abscess.

Table 4: Association between characteristics of participants and procedure failure (n=31).

Factors	Failure n (%)		OR	95% Confidence Interval	p value
Age (in years)					
< 60	4(17.5)		0.351	0.058-2.106	0.241
≥ 60	3(37.5)				
Gender					
Male	6(21.4)		0.545	0.042-7.088	0.639
Female	1(33.3)				
Number of drains					
Single	5(20.8)		0.658	0.097-4.456	0.667
Multiple	2(28.6)				
Type of imaging					
CT scan	6(37.5)		8.4	0.870-81.08	0.054
USG	1(6.7)				
Type of procedure					
Elective	6(22.2)		0.857	0.075-9.817	0.901
Emergency	1(25)				
Post op cases					
Yes	0		-	-	-
No	7(26.9)				
Drain fluid culture					
Growth	2(22.2)		0.971	0.151-6.247	0.976
No growth	5(22.7)				
Factors	**Failure**		**Success**		**p value**
	Mean	SD	Mean	SD	
Age	52.3	19.8	46.5	17.9	0.776
Size	554.4	876.4	560.5	690.5	0.787
Serum Albumin	2.98	0.78	3.16	0.61	0.492
TLC	7583.3	3470.1	14018.2	8433.5	**0.012***
Interval between onset and drainage	19.9	19.8	19.3	29.3	0.740
Average daily drain output	148.3	72.4	180.1	170.5	0.759
Drain Amylase	9546.4	16602.2	1152.2	3961.3	**0.047***
Duration of antibiotics (in days)	16.0	4.7	11.5	5.3	**0.021***

Table 5: Correlation between days for resolution and factors influencing it.

Factor	Correlation coefficient for days of resolution	p value <
Age	-0.381	0.066
Size	0.571	**0.004***
Serum albumin	0.272	0.198
TLC	0.079	0.721
Interval between onset and drainage	-0.136	0.526
Daily drain output	0.512	**0.010***
Drain amylase	-0.193	0.379
Duration of antibiotics	0.261	0.218

*p value is significant.

Discussion

Abdominal abscesses/ fluid collections owe to varied infectious/ inflammatory conditions, such as, appendicitis, cholecystitis, pancreatitis, perforation of hollow viscus etc. They may also present as a complication following intra-abdominal surgery and at times no cause is found [1-3]. The same is evident from our series. In addition to control of the source, which may or may not be feasible immediately, drainage of abscesses/ collections aid in limiting the bacterial/ septic load, thereby, taking the heat out of fire. This permits the supportive treatment, such as, antimicrobials to act and provides time for the body's immune system to play its role [3, 5]. Percutaneous drainage, additionally, limits the trauma associated with the drainage procedure and the anaesthesia needed for it, thereby proving to be minimally invasive. In critically ill patients, this is of paramount importance as most are unfit for any major surgical trauma/ anaesthesia. Even in those who are fit enough, lesser invasion translates into better patient comfort, faster recovery, shorter hospital stay and enhanced satisfaction [3].

The success rate of image guided PCD ranges widely from 70%-97% for single / late onset abscess and about 80% in cases of multiple/ early onset abscesses [5-7]. Large sized collections, multiple collections and CT guided aspirations have been found to result in higher success rate. The success rate also varies based on the type of collection: 50% for intra-hepatic abscesses; 80% for post-operative collections; 90% for primary abscesses; and 100% for cholecystitis [8]. A national survey observed the overall success rate to be 68.3%, which, after secondary percutaneous drainage, improved to 73.0% [9]. In our study, the overall success rate of the percutaneous drainage procedure for all types and locations of intra-abdominal collections/abscess was 77.4 %. This

finding is in sync with similar previous studies thereby adding greater credibility to image guided PCD as a treatment modality [10, 11].

Higher rates of procedure failure were observed among the elderly (37.5% vs 17.5%), female gender (33.3% vs 21.4%), and CT scan as an imaging technique (37.5% vs 6.7%), however, these differences were not found statistically significant. Lesser success in the elderly could be attributed to suboptimal immune response and poorer encapsulation of the infected material in them. Lesser success with CT guided drainage could be attributed to the selection bias which favoured CT for more deep seated and less accessible collections, especially of the pancreas, which is another confounding factor in our study. Our results echo that of the world literature where demographic/anthropometric factors, co-morbid conditions, ASA score, presence of fever, multiple drains and size of collections do not significantly affect the success/ failure rate [6, 10, 11].

However, our study differed in observing higher leucocyte counts, lower levels of drain amylase and shorter duration of antibiotics to be significantly associated with success. Higher leucocyte count indicates robust immune response by the body. Shorter duration of antibiotic course translates into lesser proportion of organisms being resistant to chemotherapy. Lower amylase levels are observed in those pancreatic collections without continued ductal disruption, hence, they resolve with PCD.

Escherichia coli was the commonest organism isolated from the fluid collections, an observation shared by others [5]. This is because of the gut being the source of the pathogens. A recent study found multiple drains to be necessary in 25% of the patients, with positive culture obtained in 63% of them [10]. Our observations are in contrast to this study. A lower proportion culture positivity could owe to early initiation of broad spectrum antibiotics in our cohort. Also, because anaerobic and fungal cultures of the aspirates were not undertaken. Ultrasonogram was at par with CT scan for guidance of PCD, hence, it may be preferred being easily available, cheaper and without radiation exposure. PCD has a prime role in the treatment of post-operative collections with a success rate of 81%-85.6%, an observation echoed by our study where PCD had immense success [5-7]. PCD may be complicated by bleeding, hollow viscus perforation, migration etc. However, we did not encounter any such complication but had to deal with a biliary fistula following drainage of a liver abscess, which was easily remedied by endoscopic biliary tract decompression.

Conclusion

Image guided percutaneous drainage is a safe and simple procedure for management of intra-abdominal collections. High success rates and low morbidity makes it an efficacious option, especially in post-operative collections. Low levels of drain amylase, high leukocyte counts, and shorter duration of antibiotics were found associated with successful outcome of percutaneous drainage.

Conflicts of Interest

None.

Funding

None.

Ethical Clearance

Ethical clearance was obtained from institute ethical committee.

Consent

Written informed consent was obtained from the patient.

Author Contributions

All the authors contributed equally to the conceptualisation and conduct of the study. Data collection and initial write up were done by the first author. Overall supervision, manuscript editing, and revision were done by the other three authors.

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