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ORIGINAL ARTICLE

Compliance with Evidence-Based Guidelines in Acute Pancreatitis: an Audit of Practices in University of Toronto Hospitals

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Abstract Despite existing evidence-based practice guidelines for the management of acute pancreatitis, clinical compliance with recommendations is poor. We conducted a retrospective review of 248 patients admitted between 2010 and 2012 with acute pancreatitis at eight University of Toronto affiliated hospitals. We included all patients admitted to ICU (52) and 25 ward patients from each site (196). Management was compared with the most current evidence used in the Best Practice in General Surgery Management of Acute Pancreatitis Guideline. Fifty-six patients (22.6 %) had only serum lipase tested for biochemical diagnosis. Admission ultrasound was performed in 174 (70.2 %) patients, with 69 (27.8 %) undergoing ultrasound and CT. Of non-ICU patients, 158 (80.6 %) were maintained nil per os, and only 18 (34.6 %) ICU patients received enteral nutrition, commencing an average 7.5 days post-admission. Fifty (25.5 %) non-ICU patients and 25 (48.1 %) ICU patients received prophylactic antibiotics. Only 24 patients (22.6 %) with gallstone pancreatitis underwent index admission cholecystectomy. ERCP with sphincterotomy was under-utilized among patients with biliary obstruction (16 [31 %]) and candidates for prophylactic sphincterotomy (18 [22 %]). Discrepancies exist between the most current evidence and clinical practice within the University of Toronto hospitals. A guideline, knowledge translation strategy, and assessment of barriers to clinical uptake are required to change current clinical practice.

Keywords Pancreatitis · Evidence-based practice · Professional practice · Practice guidelines as topic · Guideline adherence

Introduction

Acute pancreatitis (AP) is a common and costly illness, with an estimated incidence of just over 15,000 cases in Canada

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each year. [1] The annual cost to the Canadian healthcare system is approximately $120 million, making it the fifth most costly digestive disease. A significant proportion of the burden placed on the healthcare system by this disease is due to the antiquated dogma of "pancreatic rest", which has long been the mainstay of treatment. Over the past two decades, however, there has been increasing evidence to support changes in the approach to diagnosis, nutrition, antibiotic use, and the management of gallstone-specific pancreatitis, but adoption of these changes into clinical practice has been slow. Between 2004 and 2008, 14 clinical practice guidelines making recommendations on the management of AP were published in English language journals. [2] However, several recent studies assessing compliance with these evidence-based guidelines have shown a number of areas of discordance between guideline recommendations and clinical practice. [3–6]

In this study, we undertook a retrospective review of current clinical practice in eight hospitals affiliated with the University of Toronto. The aim was to identify whether there are gaps in the management of patients prior to implementation of a locally optimized guideline on the management of acute pancreatitis.

Materials and Methods

With approval from all hospital research ethics boards, we retrospectively reviewed the medical records of patients aged 18 years or older and admitted to any of eight University of Toronto adult teaching hospitals with a primary diagnosis of AP between January 1, 2010 and December 31, 2011. University of Toronto affiliated hospitals included Mount Sinai Hospital, Toronto General Hospital, North York General Hospital, Toronto Western Hospital, St. Joseph's Health Centre, Sunnybrook Health Sciences Centre, Toronto East General Hospital, and St. Michael's Hospital. We reviewed all AP patients admitted to the ICU during the audit period, as well as a convenience sampling of 25 AP patients admitted for treatment on the medical/surgical wards at each hospital. Only patients who met Atlanta Classification criteria for a diagnosis of AP were included in the study. These include two or more of (1) abdominal pain consistent with AP, (2) serum lipase or amylase at least three times greater than normal, and (3) characteristic findings of AP on imaging (ultrasound, CT, or MRI).[7] Patients transferred from another hospital were excluded from the study. Demographic data, as well as data on the etiology, diagnosis, and management of all eligible patients were collected.

Guideline Recommendations

Concurrent with the review, a working group of surgeons, gastroenterologists, and intensivists developed a Best Practice in General Surgery guideline on the diagnosis and management of acute pancreatitis based on a review of the available evidence and expert consensus (www.bpigs.ca). A draft guideline was distributed widely to all stakeholders (gastroenterologists, intensivists, interventional radiologists, emergency physicians, and surgeons) at the University of Toronto to obtain feedback and consensus. The guideline contains recommendations pertaining to diagnosis, assessment of severity, management of mild and severe pancreatitis, and complications of AP. For this review, only compliance with current evidence related to (1) diagnosis of AP, (2) nutrition, (3) antibiotic use, and (4) management of gallstone pancreatitis was measured. Management pertaining to nutrition and antibiotic use was analyzed for both ICU and non-ICU patients. Since this was a retrospective review, there were insufficient data or patient numbers to assess compliance for some recommendations, including those related to the management of complicated pancreatitis. Comparisons between current clinical practice and guideline recommendations are all based on the most current evidence used in the proposed BPiGS Management of Acute Pancreatitis Guideline (Table 1).

Prophylactic antibiotic use was defined as prescription of any antibiotics without a confirmed infectious etiology, for example, fever and/or elevated white blood cell count in the absence of a positive culture or imaging strongly suggestive of infected necrosis. Antibiotic prescription within 48 h of admission was considered to be part of a patient's admission orders.

Data Analysis

Patient data from all eight University of Toronto teaching hospitals in this study were pooled and analyzed together. Percentages cited represent the proportion of all study patients eligible for inclusion in each query.

Results

Two hundred forty-eight patients met the eligibility criteria. On average, 31 (range 25–40) patients were included from each hospital. A total of 34 patients were excluded from the study for reasons including transfer from outside hospitals and failure to meet Atlanta Classification diagnostic criteria. The characteristics of the eligible patients are listed in Table 2.

Diagnosis of Acute Pancreatitis

In the BPiGS Guideline (based on the most current evidence), serum lipase is the recommended biochemical test for the diagnosis of AP because of its increased sensitivity in patients who present later in their course. [8,9] Serum amylase is

Table 1 Summary of recommendations from BPiGS Management of Acute Pancreatitis Guideline

Diagnosis of Pancreatitis	
Biochemistry	Serum lipase should be performed in all patients with a suspected diagnosis of acute pancreatitis. —A threefold elevation of serum lipase from the upper limit of normal is required to make the diagnosis of acute pancreatitis.
Ultrasound	An ultrasound should be performed in all patients at baseline to evaluate the biliary tract and in particular to determine if the patient has gall stones and/or a stone in the common bile duct.
CT scan	A CT scan should be performed selectively when (1) other abdominal pathology must be ruled out or (2) in patients with suspected local complications of acute pancreatitis (e.g., peritonitis, signs of shock, suggestive ultrasound findings). CT for local complications is most useful at 48–72 h post-onset of symptoms as opposed to at the time of admission. Unless contraindicated (e.g., renal dysfunction), intravenous contrast should be given in order to assess for pancreatic necrosis once patients are adequately fluid resuscitated and normovolemia is restored.
Assessment of Severity	
C-Reactive Protein (CRP)	CRP should be performed at admission and for the first 72 h after admission. —A CRP ≥150 mg/dL at baseline or in the first 72 h is suggestive of severe pancreatitis and is predictive of a worse clinical course.
APACHE II score	APACHE II scores should be calculated on admission and daily for the first 72 h after admission. An APACHE score of 8 or higher at baseline or in the first 72 h **is** suggestive of severe pancreatitis and is predictive of a worse clinical course.
Persistent organ failure	A diagnosis of severe acute pancreatitis should be made if a patient exhibits signs of persistent organ failure for >48 h despite adequate intravenous fluid resuscitation.
Mild Pancreatitis	
Supportive care	Supportive care, including resuscitation with isotonic intravenous fluids like Ringer's Lactate, pain control, and early mobilization, should be the mainstay of treatment.
Nutrition	Patients should receive a regular diet on admission. Patients initially unable to tolerate an oral diet due to abdominal pain, nausea, vomiting, or ileus may be allowed to self-advance their diet from NPO to a regular diet as tolerated.
Prophylactic antibiotics	Prophylactic antibiotics are not recommended.
Severe Pancreatitis	
Transfer to a monitored unit	Consideration of transfer to a monitored unit should be made in patients with: a) Evidence of present or evolving organ dysfunction: • Respiratory: defined as PaO2/FiO2 ≤300, or respiratory rate >20 • Cardiovascular: defined as hypotension despite aggressive fluid resuscitation (systolic BP <90 mmHg off of inotropic support or drop of sBP>40), need for vasopressors (not fluid responsive), or pH <7.3 • Renal: ≥1.5 fold increase in serum creatinine, increase of 26.5 μmol in serum creatinine over 48 h, urine output <0.5 ml/kg/h for ≥6 h b) Need for aggressive, ongoing fluid resuscitation. • Evidence of severe hemoconcentration (Hb>160, HCT>0.500) c) Severe acute pancreatitis based on APACHE II Score >8, CRP >150 mg/L or organ dysfunction >48 h despite adequate resuscitation
Nutrition	Enteral nutrition should be commenced as soon as possible following admission (within 48 h) and is recommended over parenteral nutrition.
Prophylactic antibiotics	Prophylactic antibiotics are not recommended.
Follow-up CT scans	Follow-up CT scans should be based on the clinical status of the patient and not performed routinely at regular intervals.
Complications of AP	
FNA for infected necrosis	When there is radiological or clinical suspicion of infected necrosis in patients with acute necrotic collections (ANCs) or walled-off pancreatic necrosis (WOPN), image-guided fine needle aspirate (FNA) with culture should be performed to distinguish infected from sterile necrosis.
Sterile necrosis	Sterile necrosis based on negative FNA and/or stable clinical picture should be managed non-operatively, and antibiotics are not indicated.
Antibiotics for infected necrosis	Antibiotics should only be prescribed in patients with infected necrosis confirmed by FNA or if there is gas within a collection visualized on CT scan. Antimicrobial therapy should be tailored to FNA culture speciation and sensitivities; however, empiric treatment with antibiotics active

Table 1 (continued)

Diagnosis of Pancreatitis	
	against the most common pathogens in infected pancreatic necrosis may be considered until final culture results are available (*Escherichia coli*, Bacteroides species, Enterobacter species, Klebsiella species, and Streptococcus faecalis, as well as other gram-positive organisms such as *Staphylococcus epidermidis* and *Staphylococcus aureus*).
Interventions for infected necrosis	In patients with FNA-confirmed infections of acute necrotic collections (ANCs) or walled-off pancreatic collections (WOPN), a step-up approach of antibiotics, image-guided percutaneous drainage, followed by surgical intervention, if necessary, is indicated. Surgical consultation should occur early; however, surgical intervention should be delayed until later in the course of disease whenever possible.
Gallstone Pancreatitits	
ERCP for CBD obstruction	ERCP should be performed early (within 24–48 h) in patients with gallstone pancreatitis associated with bile duct obstruction or cholangitis. In unstable patients with severe gallstone pancreatitis and associated bile duct obstruction or cholangitis, placement of a percutaneous transhepatic gallbladder drainage tube should be considered if ERCP is not safely feasible.
Index admission cholecystectomy	Cholecystectomy should be performed during the index admission in patients who have mild pancreatitis and delayed until clinical resolution in patients who have severe pancreatitis.
Prophylactic ERCP with sphincterotomy	If cholecystectomy cannot be performed during index admission due to medical comorbidities, patients with gallstone pancreatitis should undergo ERCP with sphincterotomy prior to discharge.

Only recommendations pertinent to this retrospective review are included

recommended only if serum lipase is unavailable. Ultrasound is recommended within the first 24 h to delineate biliary anatomy and rule out gallstones as a potential etiology. [10–14] CT scan is not indicated unless (1) the patient presents with abdominal pain of unclear etiology or (2) a local complication of AP is suspected. [10] Measurement of C-Reactive Protein (CRP) on admission and daily for the first 72 h is recommended, as a value >150 mg/dL during this period is a predictor of more severe pancreatitis. [15,16]

Of the 248 patients reviewed for this study, only 56 (22.6 %) had a serum lipase as the sole biochemical test to diagnose their pancreatitis, despite the in-house availability of this test 24 h a day in all but three of the University of Toronto hospitals (Table 3). Serum lipase and amylase were both measured in 65 patients (26.2 %), while serum amylase alone was measured in 127 (51.2 %) patients. Serum CRP was measured in just one (0.4 %) of 248 patients. Diagnostic ultrasound was performed within 24 h of admission in 174 (70.2 %) patients (Table 3). Despite the fact that a biochemical diagnosis of AP was made in 179 (72.2 %) patients, 139 (56 %) patients underwent an abdominal CT scan, with 69 (27.8 %) unnecessarily undergoing both ultrasound and CT scan within the first 48 h (Table 3).

Nutrition

The BPiGS Guidelines (based on the most current evidence) recommend commencement of a patient-controlled regular diet on admission for those patients diagnosed with mild AP, to be advanced as tolerated. [17–22] In the context of severe AP, the recommendation is for early enteral feeding within the first 48 h (via nasogastric or nasojejunal feeding tube), rather than parenteral feeding in patients unable to tolerate oral feeds. [19,23–25]

Table 2 Demographics of all non-ICU and ICU patients

	All patients	*Non-ICU*	*ICU*
	n (%)	*n* (%)	*n* (%)
Total number of patients	248	196	52
Average age (range)	59.8 (22–97)	57.4 (22–97)	68.9 (28–92)
Sex (M:F)	127:121	100:96	27:25
Etiology			
Gallstone	116 (47 %)	89 (45 %)	27 (52 %)
Idiopathic	72 (29 %)	52 (27 %)	20 (38 %)
Alcohol	46 (19 %)	41 (21 %)	5 (10 %)
Mortality	17 (6.9 %)	1 (5.1 %)	16 (30.8 %)
Length of stay (mean, in days)	10.7	5.7	29.3

Table 3 Compliance between clinical practice and most current evidence (Guideline recommendations)

	Number	Percent
Diagnosis		
Total number of patients with AP	248	100 %
Lipase only	56	22.6 %
Amylase only	127	51.2 %
Lipase and amylase	65	26.2 %
Ultrasound within 48 h of admission	174	70.2 %
CT scan within 48 h of admission	139	56.0 %
CT scan and ultrasound within 48 h of admission	86	34.6 %
CRP measured	1	0.4 %
Nutrition		
Non-ICU	196	100 %
Regular diet on admission	0	0.0 %[a]
NPO on admission	158	80.6 %[a]
Average time to oral diet (mean, in days)	1.0	–
ICU	52	100 %
NPO on admission	52	100 %[b]
Average time to commencement of any nutrition (mean, in days)	3.2	–
Patients receiving EN	18	34.6 %[b]
Mean time to start of EN (mean, in days)	7.5	–
Patients receiving PN	6	11.5 %[b]
Mean time to start of PN (mean, in days)	14.8	–
Antibiotics		
Non-ICU	196	100 %
Patients receiving prophylactic antibiotics	50	25.5 %[a]
ICU	52	100 %
Patients receiving prophylactic antibiotics	25	48.1 %[b]
Patients who underwent FNA prior to antibiotics	1	2.7 %[b]

[a] percentages refer to total number of non-ICU patients

[b] percentages refer to total number of ICU patients

Of the 196 non-ICU patients, 158 (80.6 %) were maintained nil per os on admission. None of the remaining patients were given a regular diet on admission, but were started on a clear liquid diet (Table 3). The average delay from the time of admission to oral feeding was 1.0 days (range 0–6) in non-ICU patients, and a trial of clear fluid diet preceded diet as tolerated in all 196 patients.

Of the 52 patients admitted to the ICU, 18 (34.6 %) patients received enteral nutrition (EN), and six (11.5 %) received parenteral nutrition (PN), with an overlap of four patients receiving both EN and PN (Table 3). Of the 18 patients who received EN, six (33.3 %) had failed a trial of another diet first, whereas five out of the six patients receiving PN (83.3 %) had failed a similar trial before starting PN. The average delay from hospital admission to commencement of any form nutrition (EN, PN, or oral) in ICU patients was 3.2 days (range 0–12), with EN and PN groups averaging 3.3 days (range 0–12) and 2 days (range 0–5), respectively, usually failing an initial trial of clear fluid diet. The average delay from hospital admission to actual commencement of EN and PN was 7.5 days (range 0–26) and 14.8 days (range 2–48), respectively. The average duration of EN was 34.1 days (range 1–164), and the average duration of PN was 11.3 days (range 4–28). The average duration of ICU stay for patients receiving only oral nutrition, EN or PN was 12.8 days (range 1–38), 59.6 days (range 3–178), 59.3 days (range 11–178), respectively.

Antibiotic Use

The BPiGS Guideline recommends against the use of prophylactic antibiotics, based on the most current evidence demonstrating no clinical benefit, either in uncomplicated or locally complicated pancreatitis. [26–28] For patients with pancreatic necrosis, a fine needle aspiration (FNA) with cultures of the suspected infected collection is recommended and should precede treatment with antibiotics to confirm that infection is present. [29,30]

Fifty (25.5 %) of 196 non-ICU patients received prophylactic antibiotics at some point during their hospitalization (Table 3), with 44 (22.4 %) receiving inappropriate antibiotics on admission, and another six (3.1 %) patients receiving antimicrobial therapy without appropriate indication following admission, starting an average of 4.3 days post-admission (range 3–10). The average duration of antibiotic therapy in non-ICU patients was 3.8 days (range 1–9).

In ICU patients, 25 of 52 (48.1 %) received prophylactic antibiotics (Table 3), with 19 (36.5 %) receiving antibiotics without a confirmed infectious etiology at the time of admission, and another six (11.5 %) patients receiving antibiotics without indication subsequently in their ICU stay at an average of 15.5 days post-admission (range 4–38). The average duration of antibiotic therapy in ICU patients was 9.3 days (range 3–20). There were eight patients (15.3 %) who had evidence of pancreatic necrosis on imaging. Only one patient had FNA with a positive culture prior to antibiotic administration. The other seven were started on antibiotics empirically.

Management of Gallstone Pancreatitis

The BPiGS Guideline (based on the most current evidence) recommends ERCP within 48 h of admission for all patients with radiographically confirmed common bile duct obstruction, and cholecystectomy on the index admission for all patients with gallstone pancreatitis to prevent recurrent episodes of gallstone disease and pancreatitis. [31–35] The Guideline also recommends ERCP with concurrent sphincterotomy prior to discharge for those patients in whom index admission cholecystectomy is not possible due to medical comorbidities. [33,34,36]

One hundred and six of 248 patients (42.7 %) had gallstone pancreatitis (Table 4). Of the 52 patients with image-confirmed common bile duct obstruction (defined as ultrasound-confirmed dilated common bile duct with concurrent intrahepatic dilatation or either finding in the context of a visualized stone in the common duct), only 16 (31 %) underwent ERCP an average of 3.1 days after admission. Further, out of 106 patients diagnosed with gallstone pancreatitis, only 24 (22.6 %) underwent index admission cholecystectomy (Table 4). Twenty-one of 89 (23.6 %) non-ICU patients with gallstone pancreatitis underwent cholecystectomy at the time of first admission while only three of 27 (11.1 %) ICU patients with gallstone pancreatitis underwent the same. Of the 82 patients discharged without cholecystectomy, only 18 (22 %) underwent ERCP with sphincterotomy (Table 4). Thirty-two of these 82 patients (39 %) ultimately underwent interval cholecystectomy (Table 4), with a mean delay of 43.8 days (range 8–284).

Discussion

The results of our audit indicate that significant gaps in compliance with guideline recommendations do exist in both the diagnosis and management of acute pancreatitis, and there is both under and over utilization of resources and treatments. Serum amylase was measured in virtually all patients to make the diagnosis of acute pancreatitis, even though serum lipase has been shown to have a slightly higher sensitivity for detection of acute pancreatitis, elevations occur earlier and last longer as compared with elevations in serum amylase [9,37] and it is more sensitive in patients with pancreatitis secondary to alcohol. [37] Furthermore, although simultaneous determination of serum lipase and amylase only marginally improves the diagnostic accuracy of acute pancreatitis, both tests were performed in approximately a quarter of the patients. [9] Similarly, abdominal ultrasound to rule out gallstone etiology is the recommended imaging modality for patients presenting with suspected acute pancreatitis due to its low cost, availability, and lack of radiation exposure. [12] CT scan should be reserved for patients where there is uncertainty in the diagnosis or for assessment of complications. In our retrospective review, CT scan was performed in over 50 % of patients and both ultrasound and CT scan in 25 % of patients. One possible explanation for this high rate of CT scan utilization might be the study's use of the Atlanta Classification diagnostic criteria for AP, which includes in its criteria evidence of AP on radiographic imaging. Although this may have biased the results towards identifying more patients undergoing CT scan, in our study, 173 of 248 patients could be diagnosed based on biochemistry alone, and given that the Atlanta Classification diagnostic criteria are the most widely accepted diagnostic criteria for AP within the literature, we did not feel that their use introduced undue bias. Prophylactic antibiotics were also frequently prescribed, with almost half of ICU and a quarter of ward patients receiving antibiotics on admission even though several recent meta-analyses have demonstrated that prophylactic antibiotics do not reduce mortality, local, or systemic infectious complications. [26–28,38]

There are risks associated with non-evidence-based use of the aforementioned modalities and treatments including risks of unnecessary radiation exposure, antibiotic-associated infections such as *C. difficile* colitis, the development of drug resistant organisms, and the risk of superimposed fungal infections. As well, there are significant unnecessary costs incurred. Thus, in the context of the Choosing Wisely Initiative [http://www.choosingwisely.org], we would recommend that the use of routine CT scans, both serum amylase and lipase for diagnosis, and routine prescription of prophylactic antibiotics should be discouraged in patients with acute pancreatitis.

On the other hand, despite a robust body of evidence demonstrating the benefit of early enteral feeding in pancreatitis, 80.6 % of patients who were admitted to a ward setting were maintained nil per os on admission. Although the average delay until oral feeding was just 1 day, no patients were given a regular diet without passing a trial of clear fluid diet first. This practice of "resting the pancreas" is likely based on antiquated dogma about the pathophysiology of pancreatitis. Recent RCTs have demonstrated that in mild and moderate

Table 4 Management of gallstone pancreatitis

	Number	Percent
Total patients with gallstone pancreatitis	106	100 %
ERCP when indicated (radiographic CBD obstruction)	16	31 %
Average time to ERCP (*d*)	3.1	–
Index admission cholecystectomy	24	22.6 %[a]
ERCs+sphincterotomy for patients discharged without cholecystectomy	18	22.0 %[b]
Patients undergoing interval cholecystectomy	*32*	*39.0 %*[b]
Mean delay to interval cholecystectomy (mean, in days)	*43.8*	–

[a] percentages refer to total number of patients with gallstone pancreatitis

[b] percentages refer to total number of patients discharged without cholecystectomy

pancreatitis, oral feeding as soon as the patient is able is associated with decreased pain, opioid usage, food intolerance, and length of stay, and is not associated with any adverse effects. [17,18,20,22] In our study, the average length of stay was 5.7 days in the patients admitted to the ward. While the delay in feeding may not have been harmful, it may have led to a longer length of stay in this cohort. We advocate an approach which encourages patients to eat as soon as they are able; however, based on our chart review, it was impossible to ascertain whether some proportion of those patients maintained NPO were appropriately restricted from eating based on their clinical picture. While we suggest that it is best practice to adopt a patient-controlled diet as opposed to a physician-controlled approach to nutrition in mild to moderate AP, we recognize that some patients may present with AP and intolerance of PO intake such that physicians may prefer to advance their diet at a more controlled pace.

Early enteral feeding is of greater importance in the severe AP population, where commencement of enteral feeding via nasogastric or nasojejunal tube within the first 48 h has been shown to result in decreased mortality, organ failure, local and systemic infection, operative interventions, and length of stay. [19,23,25,39] Of the 52 ICU patients reviewed in this study, 34.6 % received enteral nutrition, with an average delay until commencement of 7.5 days from admission. This delay to enteral feeding, coupled with the fact that another 11.5 % of ICU patients were given parenteral feeds, which is known to be associated with inferior outcomes, [21] indicates the need for a more uniform, evidence-based approach to nutrition for pancreatitis patients in the ICU.

There is some controversy around FNA being required prior to interventions such as percutaneous drainage or necrosectomy if the clinical picture or CT scan is strongly suggestive of infected pancreatic necrosis. However, in contrast to this, our guideline recommendation is that FNA should be done before antibiotic administration so infection is confirmed in order to minimize the rate of empiric/prophylactic antibiotic use which has no demonstrated advantage and multiple disadvantages. FNA is the optimal approach to make that diagnosis. While we would agree that FNA should not be used routinely, we recommend that it should be used to guide antibiotic therapy. This approach has added benefit for clinicians with less experience in managing these patients, providing reassuring evidence to support the decision of being conservative and thereby decrease the frequency unnecessary interventions. We would add that while FNA is not needed to inform percutaneous drainage, cultures should certainly be taken at the time of drainage. Although FNA is recommended, in this study, we noted under-use of FNA and microbiological cultures of the aspirate in differentiating between pancreatitis with SIRS and the presence of infected pancreatic necrosis. [29,30] Only one of 52 patients in the ICU underwent FNA to confirm the presence of a suspected infected collection and instead it appeared that patients were empirically prescribed antibiotics for suspected infectious complications.

Several severity assessment scores have been shown to be predictive of a more severe course in acute pancreatitis, and their use can help identify patients who may benefit from admission to a monitored unit. It was difficult to ascertain retrospectively whether a severity assessment was performed. A variety of reports have correlated a higher APACHE-II at admission and during the first 72 h with a higher mortality (<4 % with an APACHE-II <8 and 11–18 % with an APACHE-II ≥8).[40–46] We could not calculate an APACHE score for the majority of non-ICU patients due to a lack of ordering or documentation of elements that make up the score. Measurement of serum CRP at admission and for the first 72 h after admission is a simple test, and serum CRP levels above 150 mg/dL during this period have demonstrated a sensitivity, specificity, positive predictive value, and negative predictive value of 80, 76, 67, and 86 %, respectively, for severe acute pancreatitis. [47] In this series, serum CRP was measured in only one patient.

Based on this audit, a clear gap in compliance with current evidence and guideline recommendations was observed in the management of patients with gallstone pancreatitis. Only one quarter of patients with gallstone pancreatitis underwent a cholecystectomy on the same admission. Furthermore, only one quarter of patients in whom an index admission cholecystectomy was not possible underwent ERCP with sphincterotomy, and only one third of patients with gallstone pancreatitis and an imaging-confirmed obstructed common bile duct had an ERCP and sphincterotomy. Recent systematic reviews including RCTs and retrospective cohort studies have shown that cholecystectomy on the same admission for gallstone pancreatitis resulted in decreases in total length of hospital stay (5 vs 7 days, $p<0.001$[35]) and readmissions for recurrent gallstone disease (0 vs 18 %, $p<0.0001$[36]). These studies also have demonstrated that many episodes of recurrent gallstone disease occur before an interval cholecystectomy can be performed, making the index admission the ideal time to reduce morbidity for patients and to minimize the overall expenditure of healthcare resources. [33,35,36] As well, several recent studies, including one systematic review of eight retrospective cohort studies and one RCT, demonstrated consistent reductions in recurrent gallstone disease, recurrent gallstone pancreatitis, and readmission when patients with gallstone pancreatitis, and too medically comorbid for index admission cholecystectomy underwent ERCP with sphincterotomy prior to discharge. [33,34,36]

There are some limitations to this review due to its retrospective nature. There is a spectrum of severity of acute pancreatitis. Because this study was performed retrospectively, we were not able to do a severity assessment and instead categorized patients by whether the patients were or were not treated in an ICU. As well, decision making may be

nuanced because of specific findings or concerns and the rationale for certain decisions was not always available. Lastly, long-term follow-up was not available.

The results of this audit show that there is a need for improvement in guideline compliance, a finding consistent with other studies examining management of acute pancreatitis following the introduction of evidence-based practice guidelines. The most commonly discordant gaps between clinical practice and recommendations include the indications for CT imaging, timing of nutritional support, indications for antibiotics, and management of gallstone pancreatitis. [48,49] These identified gaps reinforce the need for a locally relevant best practice guideline, as well as a comprehensive knowledge translation strategy to improve its uptake.

The Best Practice in General Surgery initiative was started at the University of Toronto with a goal of standardizing and optimizing care of surgical patients based on best evidence at all of the adult teaching hospitals. A number of guidelines have been developed and implemented using a systematic approach of auditing current practice, developing and implementing a guideline by engaging opinion leaders in all disciplines, presenting rounds to all stakeholders (including residents), providing easily accessible reference cards, and more recently, a mobile platform application with all of our guidelines in it, developing standardized order sets and printed educational materials, and performing practice audits with feedback. This systematic approach has been successful with the uptake of previous BPiGS clinical practice guidelines, including Enhanced Recovery after Surgery and Mechanical Bowel Preparation guidelines. The initial audit, even though it was retrospective, is an important part of the knowledge translation process as it provides clinicians with evidence that there are gaps in care. While there are a number of guidelines already published on this topic, we believe that the process of engaging opinion leaders in developing a guideline and obtaining feedback from all clinicians from the various specialties is an important component of guideline implementation. As well, the guideline can be tailored to local practice.

Performing the audit has identified several barriers which will have to be addressed. First, pancreatitis is diagnosed and or treated by various specialties including emergency room physicians, surgeons, internists, gastroenterologists, interventional radiologists, and intensivists. Agreement with the guideline recommendations by all members of the multidisciplinary team will be required to change practice. Secondly, currently serum lipase is measured in house at only five of eight University of Toronto affiliated hospitals, with delays of 2–5 days in results at the remaining three hospitals. Third, omission of CT scans at the time of diagnosis will require coordination with radiologists, ultrasound technologists, surgeons, and emergency physicians. Benarroch-Gampel et al., reported that patients with a suspected complication of gallstone disease who were evaluated in the emergency room were four times more likely to have a CT scan between the hours of 1900 and 0700. For patients undergoing both ultrasound and CT scan, 67 % underwent a CT prior to ultrasound. In other words, a suboptimal test (CT scan) was performed in place of the recommended imaging study (ultrasound) based, primarily, on its availability during the overnight hours. Finally, the likely reason for low rates of index admission cholecystectomy is the relative dearth of emergency operating room time, but given the cost in morbidity, money, and time to the patient, hospital, and the healthcare system, a strong argument may be made in favor of more operating room availability for these cholecystectomies.

Conclusion

The BPiGS Management of Acute Pancreatitis Guideline provides an evidence-based approach to the management of acute pancreatitis. This audit identified major discrepancies, including both over-utilization and under-utilization of treatments and resources, between the most current evidence and clinical practice at the University of Toronto adult teaching hospitals. A tailored knowledge translation strategy is required to increase compliance with guideline recommendations and improve clinical care. This will include addressing specific barriers to implementation of this guideline and engagement of multidisciplinary stakeholders.

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