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Clinical Review

Clinical update on management of pancreatic trauma

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Abstract

Background: Pancreatic injury is rare and optimal diagnosis and management is still debated. The aim of this study was to review the existing data and consensus on management of pancreatic trauma.

Methods: Systematic literature review until May 2018.

Results: Pancreas injury is reported in 0.2-0.3% of all trauma patients. Severity is scored by the organ injury scale (OIS), with new scores including physiology needing validation. Diagnosis is difficult, clinical signs subtle, and imaging by ultrasound (US) and computed tomography (CT) non-specific with <60% sensitivity for pancreatic duct injury. MRCP and ERCP have superior sensitivity (90-100%) for detecting ductal disruption. Early ERCP with stent is a feasible approach for initial management of all branch-duct and most main-duct injuries. Distal pancreatectomy (±splenectomy) may be required for a transected gland distal to the major vessels. Early peripancreatic fluid collections are common in ductal injuries and one-fifth may develop pseudocysts, of which two-thirds can be managed conservatively. Non-operative management has a high successrate (50-75%), even in high-grade injuries, but associated with morbidity. Mortality is related to associated injuries.

Conclusion: Pancreatic injuries are rare and can often be managed non-operatively, supported by percutaneous drainage and ductal stenting. Distal pancreatectomy is the most common operative procedure.

Introduction

Pancreatic trauma is rare compared to other solid organ injuries of the abdomen[1-3]. Incidence is difficult to properly calculate, but a Scottish population-based study found pancreatic injury to occur in 0.21% of over 52,000 trauma patients[2]. In the UK Trauma And Research Network (TARN) database there were 0.32% pancreatoduodenal injuries detected among over 356,000 injured patients[4]. A similar pancreatic injury incidence of 0.3% was noted in children in the United States National Trauma Data Bank[5]. While injuries to the liver, spleen and kidneys are far more common, pancreatic injury occurs in less than 10% of all abdominal injuries[1], depending on evaluation of the population at risk and the underlying aetiology. Penetrating injuries are far more common in regions with a high prevalence of gunshot wounds, such as in North America and South Africa[6, 7]. In most other regions, a blunt aetiology following motor vehicle crashes or falls, or 'insignificant' trauma sustained during leisure activities are the prevailing mechanism leading to this rare injury.

Notably, pancreatic trauma may frequently be overlooked or not readily appreciated on initial clinical examination and investigation. A delayed presentation or clinical deterioration of the patient may in some instances be the first clue of an underlying occult or undetected injury. Few centres have vast experience in managing pancreatic injury, but recent database reports, studies from high-volume centres and consensus reports have cast new light on the treatment and outcomes related to pancreatic injuries. The aim of this manuscript is to present an updated clinical analysis of the available knowledge for detection, classification and management of pancreatic trauma.

Methods

A systematic review of the PubMed/Medline literature available in the English language, was undertaken. Search words included wildcard search of 'pancrea*' OR 'pancreas' OR 'pancreatic' AND 'trauma' AND 'injury' combined with other key search words such as 'injury severity', 'severity scoring', 'mortality', 'imaging', 'surgery', 'endoscopy', and 'outcome'. As there were several possible diagnostic and therapeutic modalities for consideration, the PRISMA guidelines[8] for any given intervention was not formally applied. Rather, published guidelines, consensus reports, or systematic reviews and meta-analyses on all aspects of injury of the pancreas after blunt or penetrating trauma were reviewed. A predominant focus on the most recent 5 years (January 2013 to May 2018) was applied in order to present the most updated and recent data. There was no restriction of reports to any gender, age-group or region of origin, as long as published in the English language. Larger case series or registry data were included when available. Case reports and small case series were not considered unless representing unique examples or important deviations from standard practice. Further studies or references found through search of reference lists were included ad libitum for the topic under discussion.

Results

The literature search identified several systematic reviews, consensus reports, registry studies and larger single and multicentre studies (Supplemental Figure 1). A systematic review was identified on the use of amylase as a laboratory test to diagnose pancreatic injury[9], and on early use of endoscopic management[10], and there were three consensus reports for management in adults[11-13]. Two systematic reviews[14, 15] and one consensus report[16] on diagnosis and management in children were also identified. In addition, recent reports from the National Trauma Databank (NTDB) in the USA were identified and reviewed[5, 17-22]. Further, a multicentre study in adults[23] and a multicentre study in children[16] and several larger single, dual, or multi-centre cohorts were included[24-34].

Diagnostic modalities and investigation

Initial investigation and diagnosis in an acute setting should follow the general principles for all trauma patients, including an updated ATLS™ protocol[35], with imaging and monitoring according to need and vital signs on presentation. For most patients with hemodynamic stability at presentation, initial imaging is done by either ultrasonography (Focused Assessment with Sonography for Trauma; FAST) or more usually by multidetector computed tomography (MD-CT) – both of which have low sensitivity for pancreatic injury, typically reported at 40-60%[36-38]. Patients who present with unstable vital signs or in extremis may be taken immediately to the operating theatre for exploration and resuscitation, thus, foregoing any imaging as diagnostic support. Diagnosis of a pancreatic injury may then first be detected at the time of laparotomy.

It is important to note that early clinical signs of pancreatic injury are vague, laboratory tests are nonspecific and imaging results may be subtle and overlooked. Thus, a high degree of clinical suspicion is needed to ensure the potential of such injury is not overlooked. In blunt injury, a ‘seat belt’ sign over the abdomen after a motor vehicle crash, or a history of a handle bar injury in children presenting with abdominal symptoms may raise the suspicion of an underlying pancreatic injury.

Elevations of lipase and amylase are generally mild and non-specific less than 6 hours after injury, but the sensitivity increases with time and with consistent elevation in enzymes[9]. However, it should be noted that these enzymes can also be elevated for other abdominal injuries [39], and higher enzyme levels are not associated with higher grades of pancreatic injury[40]. Thus, increased levels of amylase or lipase are not specific for pancreatic injury, but may raise diagnostic suspicion to pursue further imaging in patients with equivocal clinical findings.

In general, US and CT are reported to have an overall low sensitivity for pancreatic injuries[41]. CT findings of pancreatic trauma can be broadly categorized as direct or “hard” signs, such as a pancreatic laceration, which tends to be specific but lacks sensitivity, or as indirect or “soft” signs, such as peripancreatic fluid, which tends to be sensitive but lacks specificity[37, 42, 43]. However, newer multidetector CT may have sensitivities approaching 80% and higher specificity for ductal injury[23, 43]. A CT-based score proposed that parenchymal transection of over 50% of the pancreatic gland had a high risk of ductal disruption[44], but was based on CT-technology that is currently surpassed. Current MD-CT is both faster and has higher resolution and is therefore the primary imaging modality in trauma patients[45]. Due to the rarity of pancreatic injuries, studies reporting actual sensitivity data for CT are lacking. However, both MRCP and ERCP have higher sensitivity (approaching 100%) and each have their own indications when pancreatic injury and ductal disruption is suspected[37, 38, 46]. MRCP has the advantage of being non-invasive and is the first choice in a stable patient with suspicion of a pancreatic injury and to diagnose any injury to the pancreatic duct. Intraparenchymal hematoma may cause duct compression (showing as loss of duct on imaging). Differentiation from a true duct disruption may require ERCP to demonstrate contrast extravasation from side- or main-duct injuries. In theory, secretin-enhanced MRCP should improve the diagnostic yield, but there are only a few case series of its use for pancreatic trauma[47, 48], so no current valid recommendation can be made for this technology. Consideration of the use of secretin-enhanced MRCP must be based on the quality of other imaging available (ie the type of CT or MR) and radiological recommendation and institutional experience with this technology. For equivocal findings on MRCP, the current approach would be to proceed to ERCP. Although an invasive test, ERCP remains the 'reference standard' and also has the advantage of facilitating therapeutic intervention, by insertion of a stent as an initial temporary attempt at management in otherwise stable and well patients.

Scoring of injury types and severity

A common nomenclature for defining injury severity is important for comparison of results and defining treatment strategies for specific injury types. The Organ Injury Scale[49] (OIS) score is universally used by trauma registries as a standard for reporting type and severity of pancreatic injury (**Figure 1**). Other available scoring systems exist[50], such as the Frey & Wardell[3] or the Lucas score[51] that take into account associated duodenal injuries, but these are rarely, if ever, used for reporting in the literature with no major series or authoritative review published over the past decade suggesting any of these scores used to assess combined pancreatoduodenal injuries[17, 30, 52-57]. However, the combined grading of pancreas and duodenal injury together may have some clinical value for practical decision-making. Currently, most series describe these rare combined injuries by the OIS score for pancreas and duodenum[49]. Notably, such combined injuries occur in a rare minority of patients, reported to occur in less than 8% of all children with pancreatic injury[58] and in just over 8% in all patients with pancreatic trauma[54]. As such, it is recognized that for this select patient group, the severity scoring may have less validity and precision for therapeutic decision-making. Largely, experience stems from institutional series with high-volume trauma related to penetrating mechanisms[17, 52, 56, 57, 59].

The OIS scoring system describes the anatomical relation of the injury with a focus on the location (head, body, tail) and the duct (involved, non-involved). This system neglects the overall injury burden to the patient, including the physiological state at presentation, which is usually highly predictive of outcome. It has been suggested that a system that considers other injures and the presence of shock should be used to separate the 'good' from the 'bad' and the 'ugly' injuries, and to relate management to outcome (**Table 1**)[60]. Krige et al[32] suggested a Pancreatic Injury Mortality Score (PIMS) as a composite outcome score based on 5 variables (**Table 2**) and found an overall good prediction (AUC of 0.84) in a series of 473 patients with pancreatic injuries. Further external validation is needed to test the robustness of this score, but this may prove difficult given that few, if any centres, have the same experience as the vast numbers reported by the Cape Town group over the years[7, 32, 33, 61-63].

Management

As addressed in recent systematic reviews and consensus reports[11, 12, 14-16], there is scant evidence on which to base current decision-making and management plans. The only two consensus reports that have formally graded the evidence by recognised methodology found weak evidence to make recommendations. In the Eastern Association of Surgery for Trauma (EAST) guidelines using the Population, Intervention, Control, Outcome (PICO) approach, the consensus panel found very low quality evidence with serious risk of bias across all studies used to make recommendations regarding operative versus non-operative management for both grade I/II injuries and for grade III injuries and above[12]. Similarly, most statements from an International Consensus Conference[11] using the GRADE[64] system, were 'weak recommendations (2B or 2C)' based on 'weak' or 'very weak' evidence [11]. This must be kept in mind when considering recommendations for any approach in management.

In general, trauma to the pancreas may present in any form, ranging from the mildest type with symptoms resembling mild pancreatitis with transiently elevated serum amylase and lipase after a traumatic insult, to severe pancreatic parenchymal injury, sometimes causing extreme disruption or complete transection of the gland necessitating surgical intervention (**Figure 2**). For adults, consensus guidelines have been put forward to suggest best management[12], but the evidence is scarce and the proposed strategies are based on scant data. As for children, there is controversy still to the best management in high-grade injuries[22, 28]. An outline for management has been suggested in **Figure 3**.

Conservative management

For patients who present with a 'traumatic pancreatitis', management should commence in a conservative manner, with fluid support, pain control and monitoring of vital signs. These patients usually have no other signs and will likely have a transient increase in lipase levels, which may occur hours after the mechanistic injury and settle without further management.

Typically, no specific signs of injury are seen on cross sectional imaging, other than possible signs of 'pancreatitis'.

For grade I-II injuries, the treatment would primarily commence with a non-operative, supportive management strategy (**Figure 3**). Only for grades III-V injuries should resection, rather than conservative management, be considered. Based on available studies, there seems to be no benefit in terms of mortality with resection over conservative management, but a decrease in length of stay may be achieved with surgery[20]. A recent paper has summarized the conservative strategies in pancreatic trauma in an acronym, dubbed as the acronym 'SEALANTS' approach[65] based on use of Somatostatin analogues, External drainage, ALternative nutrition, Antacids, Nil per os status, Total parenteral nutrition, and Stenting of the pancreatic duct. The authors suggest that, rather than introducing these in a stepwise fashion, they should be delivered in a 'shotgun' approach, with all elements commenced at once. The SEALANTS approach to pancreatic duct disruption is based on extrapolation of results from diverse fields in pancreatology and is only based on anecdotal experience[65]. Moreover, some of the elements of the SEALANTS approach, such as the recommended use of somatostatin-analogues, are in conflict with the EAST consensus[12], which does not support the use of octreotide. This highlights that opinions are based on weak data with variable interpretation, and thus institutional practice and extrapolation from other fields of medicine may influence interpretation of data and management preferences.

Endoscopic management

Endoscopy may have a central and early role in management and healing of minor duct leaks in some pancreatic injuries (**Figure 3**) and facilitate non-operative management by stenting and drainage in patients with delayed presentation of pseudocysts and collections[66]. Based on data in a systematic review[10], it is suggested that early ERCP and ductal stenting may lead to resolution of symptoms and healing of the injured duct in selected cases (30-100%), even for grade III injuries, thus avoiding major laparotomy and resection[10]. Notably, data are based on case series with variable outcome, but endoscopic management has gained both popularity and success, even for main duct disruptions[10, 27, 66-70].

Specific endoscopy-based scoring systems for pancreatic duct disruption after blunt trauma have been proposed in a small series from Kanagawa, Japan[71] and a later modified version from Cape Town, South Africa.[67] These scores are quite detailed, with 4-5 categories and several subcategories, thus questioning the robustness of each subcategory. Furthermore, only a proportion of patients undergo ERCP so this restricts the generalizability of the score.

Also, none of the scores have been validated in larger, external series. However, both scores point to a high success rate for conservative management of ductal injuries restricted to involve side-branches only. Thus, the scores may be used in patients who proceed to ERCP based on suspicion of, or confirmation of, ductal involvement on MRCP.

Another more generic endoscopy-based classification system[72] that may also be applied to ductal leaks caused by injury to the pancreas has been suggested (**Table 3**). Notably, the system is largely based on development of a fistula or leak after elective pancreatic surgery, so extrapolation of the findings to the trauma setting run the risk of bias or lack of validity. However, in the setting of isolated injuries to the pancreas, the same principles may apply as for post-operative pancreatic fistulas. In this system, type I leaks occur after injury to the pancreatic parenchyma with leaks from small side braches or from the very distal end of the pancreatic duct (tail, IT). The leaks are usually minor with low output and usually heal after pancreatic stenting or nasopancreatic drainage followed by stenting that bridges the leak or at least crosses the sphincter of Oddi enabling decompression of the pancreatic duct. Successful endoscopic stenting as a final therapy is usually reported to be associated with a relatively low prevalence of trauma-related leaks in these series[25].

Surgery and resection

When laparotomy is indicated for other reasons, such as damage control surgery in hemodynamically challenged patient, a pancreatic injury may be found as part of the injury spectrum (**Figure 3**). Decisions to drain, repair or resect may be determined based on the perceived benefits or risks of management of the concomitant injuries, e.g. a splenectomy may be done as part of a distal pancreatectomy if the patient is unwell and the risk of organ-salvage outweighs the benefit of immediate surgery[12, 21, 73]. Spleen-preserving distal pancreatectomy for trauma is more likely to occur in younger patients with a lower injury score after blunt trauma[21]. Advice on whether to routinely perform splenectomy or splenic salvage remains equivocal in the EAST consensus based on the scant data available[12].

Early operative management in patients with pancreatic injury is usually indicated in patients with pancreatic gland injury with severe ductal transection, in those with associated multiple other injuries or vessel injuries and in patients with deranged physiology on admission. In patients with blunt trauma, it is usually the complexity of the pancreatic injury and the subsequent complications that determine the morbidity and length of stay, whereas the presence of concomitant vascular injuries usually determines mortality[74]. In a small, select subgroup of patients, damage control surgery is warranted as a life-saving procedure for these injured patients[59, 75].

A 'trauma Whipple' is rarely indicated, and only 47 cases were identified when reviewing the National Trauma Database (NTDB) for the years 2008-2010[17]. Indeed, in the two largest series to date, only 15 Whipple procedures were done for pancreatic trauma in Seattle, Washington over a 15-year period[76] and 19 in Cape Town, South Africa over a 22-year period[77]. Pancreatoduodenectomy for trauma remains a rare procedure outside very high-volume centres[75-77], with most other documentation in the literature being occasional case reports. Penetrating mechanisms account for 70-80% of such injuries requiring resection; immediate resection is typical for injuries to the body and tail, while pancreatic head injuries can be managed either as a staged procedure as part of damage control surgery or following the surgical placement of drains. The associated mortality is high[17, 75, 76]. For most hospitals encountering a type of injury that would necessitate a pancreatoduodenectomy, other injuries should take precedence and initial surgical drainage of the pancreatic bed is appropriate until the patient is well enough to undergo final definitive surgery or referral to an appropriate centre with trauma and pancreatic surgery expertise to deal with the injury. Penetrating trauma to the 'surgical soul' involving major vessels such as the portal vein, inferior vena cava or mesenteric arteries is highly lethal and control of haemorrhage takes precedence over any pancreatic resection or reconstructive attempts.

Management of pancreatic injury in children

Pancreatic injuries in children are somewhat different from those occurring in adults. In children, pancreatic injury occurs in approximately 0.3% of all injuries and 0.6% of all abdominal injuries, making pancreatic trauma a relatively rare event overall[15]. One fifth of the pancreatic injuries are isolated and occur after relatively minor incidents[15], such as 'handle bar injuries' from falling on a bike[34], sport activities, or other similar mechanisms[15, 78]. Thus, children may not initially present following the same injury mechanism as adults, and may present late or with so-called 'occult injury', with a dull, non-specific, diffuse abdominal pain after an apparently minor insult (**Figure 3**). As children may be less likely to undergo CT for what are perceived minor injuries, one should recognize the low sensitivity of ultrasonography and have a high degree of suspicion and a corresponding low threshold for CT or MRI if symptoms do not settle, or if blood results or vital signs indicate changes that need further investigation.

Two recent systematic reviews of children with pancreatic injury[14, 15] included some 20 studies each for a total of almost 1000 patients. Pancreatic injury is the fourth most frequent abdominal organ injury in children and mostly occurs in the age-group between 5-18 years[15]. Handlebar injury to the abdomen is reported as the trauma mechanism in about a quarter of all children[14]. Most children with grade I-II injuries can be managed non-operatively (**Figures 1 and 3**), while about 50% of grade III-V injuries can be managed non-operatively[14, 15]. The most frequent complication associated with non-operative management is development of a pseudocyst which occurs in almost 15-20% of patients, but about half to two-thirds of these can be handled non-operatively and recover without further operative management[14, 16, 18]. Notably, it is recognized that there is high variability between surgeons in terms of choice of management of pancreas injury in children, particularly for high-grade injuries[28, 29], and there is considerable heterogeneity in the case series reported[28]. This is largely reflected in variation in outcomes such as time to enteral nutrition and length of hospital or intensive care stay, but not in mortality[16, 18]. Generally, non-operative management in children is successful and surgery is most often undertaken for injuries to the tail (**Figure 2**) with ductal disruption[5, 16, 18]. Morbidity from the injury remains high. Mortality from pancreatic injury is rare in children and is usually attributed to associated injuries, such as severe head trauma[14, 15].

Outcomes after pancreatic injury

Short-term outcome

Mortality depends on a number of associated factors and is rarely caused by the pancreatic injury itself. In children, the mortality is reported to be very low[18, 34], with most deaths attributed to other severe injuries of the head and chest[15]. The outcome after penetrating injuries differs between stab wounds and gunshot wounds, with stab wounds[79] having a lower risk of overall mortality (<5%) compared to gunshot wounds (>20%)[7], likely reflecting the higher velocity and energy involved with increased risk of additional vascular injures in the latter. While mortality after stab-wounds is relatively low, the morbidity is high, with pancreatic fistulas developing in over 10%[79, 80]. As noted previously, associated organ injuries, vascular involvement and physiological compromise (e.g. shock) are strong predictors of mortality in these patients.

Long-term outcome

Overall, long-term outcome is good as the majority of injuries are low-grade and self-limiting with supportive care. The most prevalent sequela across injury severity types appears to be the risk of pseudocyst development. Pseudocysts may be dealt with as for other aetiologies, for which conservative observation is the predominant initial approach. However, a more aggressive approach towards pancreatic duct stenting can be considered, given that the pseudocyst likely reflects disruption of ductal structures after trauma, rather than general inflammatory changes, as seen in acute pancreatitis. Drainage procedures for unresolved pseudocysts should be dictated by symptoms and anatomical location, with preference for minimally invasive internal drainage procedures such as an endoscopic cystgastrostomy over open surgery whenever possible.

In the very long-term, exocrine and endocrine function appears to be related to overall age and time from injury rather than the surgical treatment per se[81]. To date, no long-term assessment in a large series of all patients following pancreatic injury has been undertaken, so extrapolation from patients with pancreatitis-sequelae or who have undergone distal or pancreas head resections for other benign conditions may be used for assessing the long-term outcome in terms of both endocrine and exocrine function.

Conclusions

Pancreatic injuries are rare and usually of a severity that can be managed non-operatively with a high degree of success. Serum amylase as a screening test is unreliable for diagnosis. CT is less reliable as an imaging tool, and MRCP is the preferred choice for cross sectional imaging. ERCP may be useful for confirmation if a ductal leak is suspected, both to diagnose and to treat with a stent as an initial management (**Figure 3**). Ductal disruption can be handled by early stenting with or without drainage in many cases, but distal resection may be an alternative. Severe disruption and associated parenchymal tissue loss is more frequent in severe penetrating injuries and may require urgent surgery. Non-operative management has a high degree of success, particularly in children. A pseudocyst may develop in one-fifth of all patients, with most managed conservatively. Long-term exocrine and endocrine function is generally good and usually related to patients' age and time from injury. The evidence-base for decision-making remains scant and largely based on registry data and retrospective multicentre observational studies.

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Figure legends:

Figure 1. The organ injury scale (OIS) by American Association for Surgery of Trauma (AAST) for pancreatic injury severity.

Legend:

	GRADE *	INJURY DESCRIPTION
I	Hematoma	Major contusion without duct injury or tissue loss
	Laceration	Major laceration without duct injury or tissue loss
II	Hematoma	Involving more than 1 portion
	Laceration	Disruption <50% of circumference
III	Laceration	Distal transection or parenchymal injury with duct injury
IV	Laceration	Proximal (to right of superior mesenteric vein) transection or parenchymal injury
V	Laceration	Massive disruption of pancreatic head

* advance one grade for multiple injuries to same organ, from Moore et al [49].

Figure 2. Intraoperative finding of a grade III pancreatic injury.
Pancreatic injury sustained after blunt injury. A distal pancreatectomy and splenectomy was performed. Arrows point at pancreatic transection. “P” indicates the pancreas. (Image courtesy Dr TG Weiser)

Figure 3. A proposed, simple management outline for pancreatic injury.
For details, see description in the main body of the text.

Supplementary info

Figure S1. PRISMA flow chart.

Table 1. Classification of pancreas injury into good, bad and ugly.

Pancreas injury grade[1]	Physiology	Other injuries	Treatment	Risk of Morb.	Risk of Mort.	Classification[2]
Grade I-II	No shock	Absent	NOM ± drain	0-10%	<5%	**Good**
	Shock	Present		>10%	<10%	**Bad**
Grade III	No shock	Absent	NOM ± Resection	10-50%	<10%	
	Shock	Present		25-50%	10-20%	**Ugly**
Grade IV-V	No shock	Absent	Resection, staged	>50%	<20%	
	Shock	Present		>50%	20-50%	

[1] OIS/AAST grade

[2] suggestion based on the subsequent risk of complications and/or mortality,

NOM denotes non-operative management

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Table 2. Scoring rubric for the Pancreatic Injury Mortality Score (PIMS).

Age>55 years	**Points**
Yes	5
No	0
Shocked	
Yes	5
No	0
Major vascular injury	
Yes	2
No	0
Number of associated abdominal injuries	
None	0
1	1
2	2
≥3	3
AAST pancreatic injury scale	
I	1
II	2
III	3
IV	4
V	5
Total Score	**x/20**

RISK GROUPS	**PIMS score**	**Mortality estimates**
LOW	0-4	Low <1%
MEDIUM	5-9	Medium 15-17%
HIGH	10-20	High 50%

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Table 3. Endoscopy-oriented classification of pancreatic leaks and suggested management

Leak type	Subtype	Endoscopic intervention
I	Head (IH)	Bridging stent or nasopancreatic drain
	Body (IB)	Bridging stent or nasopancreatic drain
	Tail (IT)	Bridging stent if duct caliber allows or Cyanoacrylate/fibrin glue/other polymer injection at pancreatic tail/fistulous tract
II	Open proximal stump (IIO)	Bridging stent or
		nasopancreatic drain or
		Extrapancreatic transpapillary protruding stent
	Closed proximal stump (IIC)	EUS + transmural drain of fluid collection from the distal gland into stomach/intestine or
		EUS-guided pancreaticogastrostomy or Conversion to open + bridging stent/ nasopancreatic drain
III	Proximal (IIIP)	Transpapillary protruding stent to drain the collection
	Distal (IIID)	Drain the CBD and the jejunum at the level of anastomosis EUS for transmural drain of peripancreatic collections or pancreaticogastrostomy

According to the anatomic location, type I fistulas are further classified as H (head), B (body), and T (tail).

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PRISMA 2009 Flow Diagram

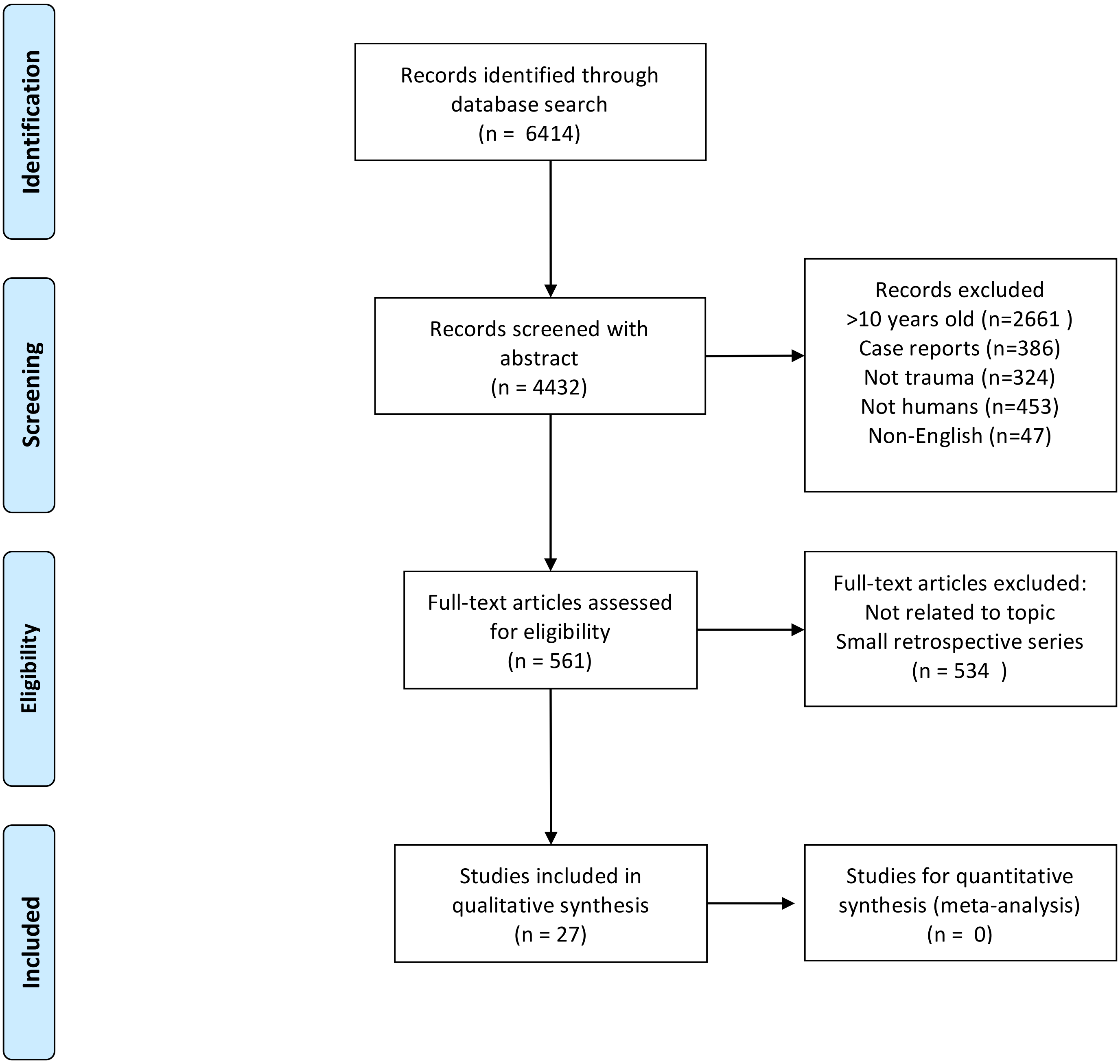

Figure 1

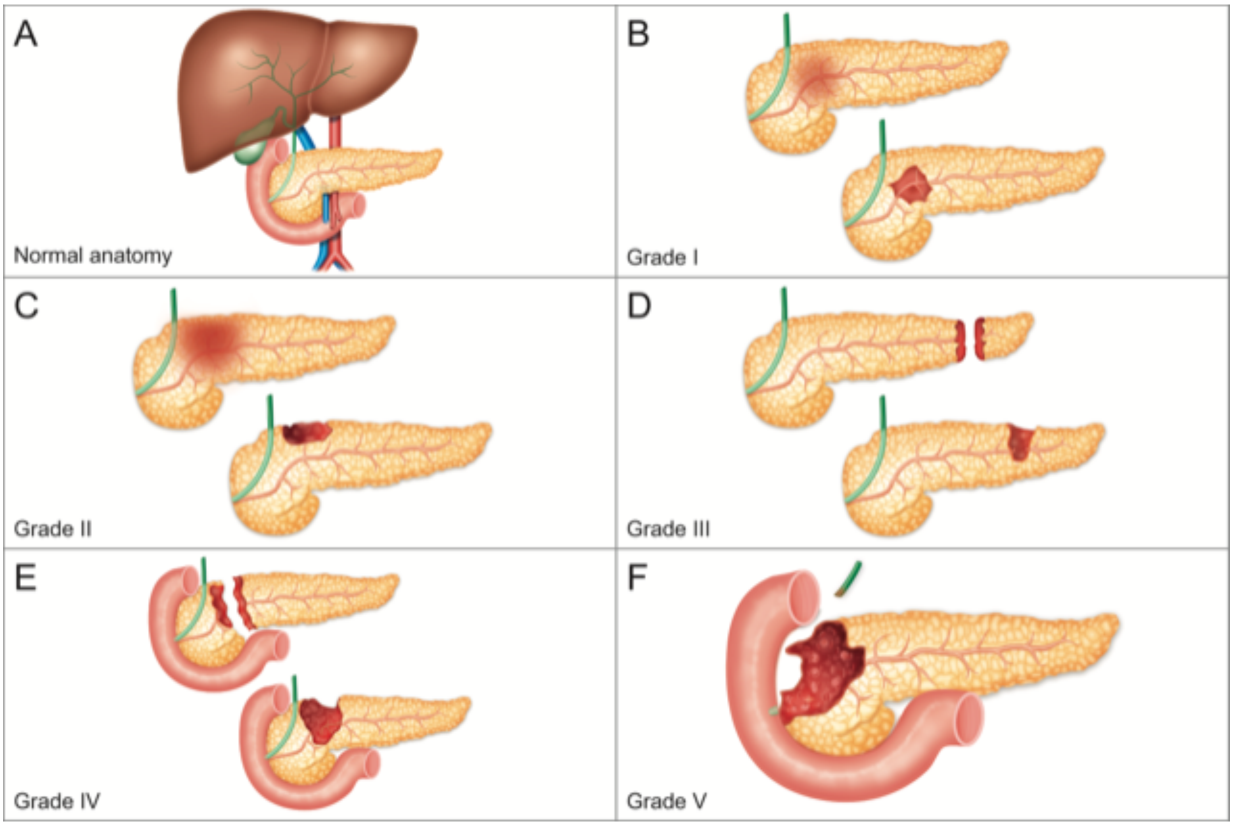
A
Normal anatomy
B
Grade I
C
Grade II
D
Grade III
E
Grade IV
F
Grade V

Figure 2