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## *Clinical Review Article*

# THE CURRENT MANAGEMENT OF THE DIFFICULT DUODENUM

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## **ABSTRACT:**

### **Introduction:**

The management of the difficult duodenum (giant duodenal perforations and complex duodenal injuries) remains a great challenge and nightmare to all general surgeons. Duodenal stump leaks often lead to significant morbidity and mortality. Multiple surgical modalities are available for dealing with this pathology, but no single technique has proven effective for all conditions.

Currently there are no standard guidelines on how to manage these conditions. The surgeon needs to be aware of the pros and cons of each technique, prior to implementing its use. The aim of this review article is to do an up -to-date literature search of the various surgical techniques used to



manage this condition and also to increase awareness of the advantages and limitations of each technique.

### **Methods:**

A broad PubMed and Cochrane database search was conducted on complex duodenal injury and giant duodenal perforations. All available abstracts were reviewed for each of the various techniques used in management of these conditions. The methods, findings and complications of these were analysed and documented, and suggestions/recommendations were noted.

### **Results:**

There is no standard guideline for management of these injuries in the current literature. In giant duodenal perforations, primary repair with omentopexy seems to be the prudent choice in these patients, due to its ease of performance and relative safety. In complex duodenal injuries, tube duodenostomy is safe, easy to perform and an efficient way to temporise, thus allowing a controlled procedure to be done in a non-emergency setting.

### **Conclusion:**

Difficult duodenal injuries remain a challenge to any general surgeon. Currently, there are no randomised controlled trials or prospective studies on management of this condition, due to its rarity. However, tube duodenostomy has proven to be both safe and effective in the emergency setting, in some patients with this pathology. If possible, these patients should be admitted to a dedicated hepato-pancreatico-biliary centre for immediate and further care. Each patient should be



managed on a case-by-case basis, and the haemodynamic status, surgeon's experience and available facilities taken into consideration.

## INTRODUCTION:

The duodenum is the first part (5-7 m) and also the widest and shortest (25 cm) part of the small intestine. It is a C-shaped or horseshoe-shaped structure, and it lies in the upper abdomen near the midline. Clinical significance of the duodenum includes its role in digestion, where it is an important site of enzymatic release, and regulation. It is also the location of the Ampulla of Vater, where the biliary and pancreatic ducts empty, and is intimately associated with the head of the pancreas. Therefore every effort should be made to preserve the duodenum, and to appreciate the complex anatomy that surrounds it. Duodenal injuries can pose a significant challenge to the general surgeon due to friable duodenal margins in a typically moribund patient. These injuries are relatively rare, rendering it unlikely that many practicing surgeons will have extensive experience in managing these cases. The consequences of inadequate repair can be devastating, leading to delayed leaks, widespread abdominal contamination, sepsis and death <sup>[1-3]</sup>. A high incidence of dehiscence and hospital mortality (15-40%) has been reported with the majority of the techniques. Simple duodenal perforations usually result from peptic ulcer disease or endoscopic intervention, and can be treated with primary repair or with an omental patch <sup>[4]</sup>. In contrast, several procedures have been described for large duodenal perforations, ranging from drainage and pyloric exclusion to pancreatico- duodenectomy <sup>[5-8]</sup>. While effective, many of these operations are technically demanding and require long operative times, neither of which are ideal for patients with sepsis who are often hemodynamically unstable and displaying shock physiology by the time the diagnosis has



been made <sup>[9-10]</sup>. Therefore, the ideal repair should be simple, easily learned and able to be performed quickly in a damage-control fashion. Tube decompression of the duodenum was initially utilized in management of the duodenal stump after gastrectomy, in order to prevent blow-out of the duodenal stump at the suture line <sup>[11]</sup>. Over the years, tube duodenostomy has proven to be a safe and effective technique in the management of the difficult duodenal injury <sup>[12]</sup>. However, it has not gained universal acceptance and has been underutilized, despite good outcomes. Recently, a limited number of case series have been published on the application of tube duodenostomy in the management of giant duodenal ulcers and traumatic injuries <sup>[12-15]</sup>.

**Keywords:** Difficult Duodenum, Giant duodenal ulcer perforation, difficult duodenal injuries, techniques of management of difficult duodenum.

## **METHODS:**

A literature review was conducted using Medline/PubMed and the Cochrane Database, using the keywords “giant duodenal perforation” “omentopexy” “complex duodenal injury” “difficult duodenum” “tube duodenostomy” “pyloric exclusion and gastrojejunostomy” “jejunal serosal patching” “pancreas-preserving duodenectomy” “Roux-en-Y duodeno-jejunostomy” “Whipple’s procedure”. Only published research was utilised in our paper. A secondary source search was also done for relevant articles. All available abstracts on the surgical techniques utilised were analysed, and findings, suggestions and recommendations were noted and discussed.

## **Giant Duodenal Perforation:**



Despite the efficacy of medical treatment for peptic ulcer disease (PUD), a steady increase in the complications of PUD have been reported due to increased NSAIDs consumption in the last few decades <sup>[16-19]</sup>. Ulcer perforations represent 10-20% of the surgical complications of PUD, having recently raised the attention of several authors <sup>[17,18]</sup>. Very little data is available in literature regarding the definition, incidence, and the management of large perforations of duodenal ulcers. The perforated giant ulcers comprise about 1-2% of the perforated duodenal ulcers and are associated with a high morbidity (20-70%) and mortality (15-40%). The reported mortality rate varies between 1.32% to nearly 20% in different series <sup>[20]</sup> and recent studies have shown it to be around 10% <sup>[21]</sup>.

The size of the perforation in peptic ulcers can vary from 3mm to over 3cm in diameter, which adversely affect the prognosis. If the perforation is less than 5mm in diameter, there is a 6% mortality rate, between 5mm and 10 mm the mortality goes up to 19%, and when it is more than 10mm, the mortality rate is about 24% <sup>[22]</sup>. Commonly, duodenal ulcer perforations are less than 1 cm in greatest diameter, and as such, are amenable to closure by omentopexy <sup>[17, 23]</sup>.

The size of 'giant' perforations has arbitrarily been defined by various authors as being greater than 0.5 cm <sup>[24]</sup>, 1 cm <sup>[23, 25]</sup> or 2.5 cm <sup>[26]</sup> in greatest diameter, but we failed to uncover any specific size in available English language literature beyond these, which labels these perforations as "giant".

Although the size of a perforation is an important measure in determining the outcome, a review of literature failed to reveal any accepted definition of either small or giant perforations of duodenal ulcers. Neither could we come across any specific recommendations regarding the management of giant / large perforations, which are said to be "difficult" to manage and have anecdotally been associated with high leak rates and mortality. In contrast, there is a well-accepted definition of giant



duodenal ulcers (more than 2 cm in size), which may or may not perforate, but are considered to be an indication for definitive, elective ulcer surgery.

According to Gupta et al<sup>[17]</sup>, duodenal perforations can be classified into three main groups:

1. small perforations, less than 1 cm in size, and have the best outcome
2. large perforations, between 1 cm and 3 cm
3. giant perforations, that exceed 3 cm size

The usage of the word 'giant' for a duodenal perforation should be restricted to such large defects, where omentopexy may be deemed unsafe, and other options may be thought to be necessary.

Management of these patients represent a surgical challenge regarding the closure of the severe duodenal wall defect and surrounding inflammation<sup>[15, 27-29]</sup>. These perforations are considered particularly hazardous because of the extensive duodenal tissue loss and surrounding tissue inflammation, which are said to preclude simple closure using omental patch, often resulting into post-operative leak or gastric outlet obstruction<sup>[23, 25]</sup>.

The tendency to leak may further be aggravated by the high intraluminal pressures, extrusion of the duodenal mucosa through the closure, and auto digestion by the pancreatic enzymes and bile, thereby further compromising an already sick patient<sup>[29]</sup>.

Similar to giant duodenal ulcers, there is no clear cut definition to what should be classified as a complex duodenal perforation and if/when to use extensive surgery for repair. For traumatic injuries, there is a de facto approach as to classify American Association of Surgery for Trauma-Organ Injury Scale grade III or greater injuries as complex duodenal injuries. Blunt trauma, bullet



wounds, diagnosis delayed over 24 hours, and injuries to the second portion of the duodenum frequently cause surgeons to consider complex repairs <sup>[30-32]</sup> .

Several risk factors are associated with high mortality in these patients such as-

- Advanced age
- Concomitant disease
- Preoperative shock
- Size of the perforation
- Delay in presentation and operation <sup>[21, 28, 33]</sup> .

A prospective study of 113 consecutive cases <sup>[16]</sup> found that age > 70 years, the presence of shock at the time of admission, a delay > 24 hours in the diagnosis, and concurrent medical illnesses were related to increased hospital mortality. Several other factors are also associated with increased mortality such as, the ASA physical status (American Society of Anaesthesiologists), hypoalbuminaemia, increased serum creatinine level and metabolic acidosis <sup>[16-18, 34]</sup> . The absence of shock at presentation, younger age, early presentation, good ASA grades and as well as good postoperative supportive care may be responsible for the good outcomes in both of our patients.

### **Surgical management of Giant Duodenal Perforations:**

This remains a controversial issue. Traditionally, surgery was the treatment of choice. However, there are proposed guidelines for selection of patients in whom conservative management can be attempted. Surgery should not be delayed in large duodenal perforations in ill patients, where pain and abdominal signs are prominent. The type of surgical repair should be individualized taking into



consideration the extent of the duodenal injury, other associated injuries and the co-morbid conditions of the patients (figure 1).

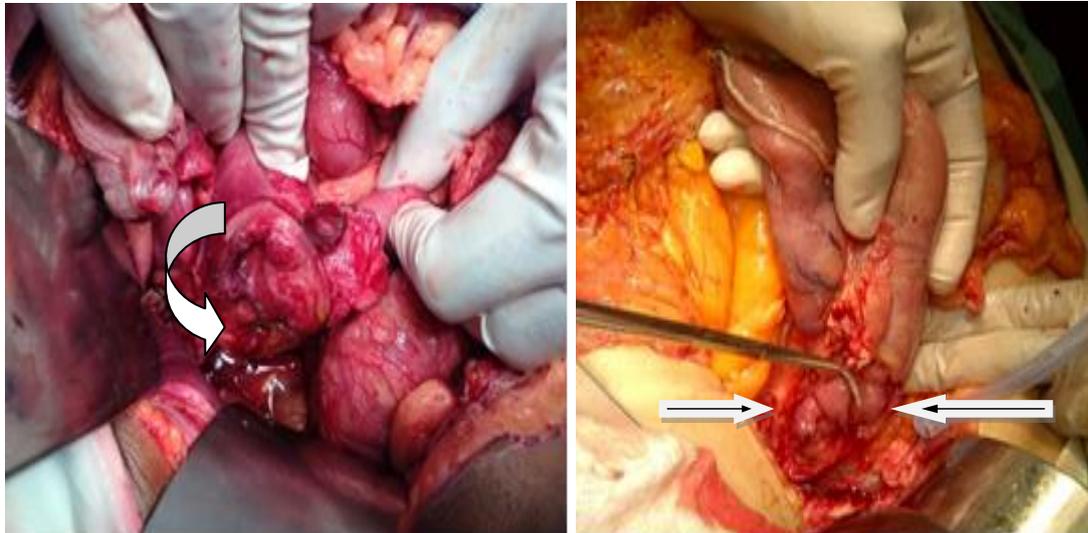


Fig 1: Intra-op view showing giant D2 ulcers (a, b)

In the absence of any specific definition and guidelines regarding the management of giant perforations in literature, different authors have recommended varied surgical options from time to time, based on their experience and research. These have included resection of the perforation bearing duodenum and the gastric antrum in the form of a partial gastrectomy, with reconstruction as either a Billroth I or II anastomosis, or the more morbid procedure of gastric disconnection in which vagotomy, antrectomy, gastrostomy, lateral duodenostomy and feeding jejunostomy are performed, with restoration of intestinal continuity electively after 4 weeks of discharge <sup>[35]</sup>. Others have recommended conversion of the perforation into a pyloroplasty, or, closure of the perforation using a serosal patch or a pedicle graft of the jejunum, with or without pyloric exclusion. Also, the use of a free omental plug to patch the defect, and even suturing of the omentum to the nasogastric tube are described in the literature <sup>[23-26, 35-39]</sup>.



Proximal gastrojejunostomy and/or vagotomy may be added to these procedures to provide diversion and a definitive acid-reducing procedure respectively <sup>[35]</sup>. However, each of these procedures not only prolongs the operating time, but also requires a level of surgical expertise that may not be available in an emergency setting. In addition, each of these procedures has its own morbidity that may add up to significantly alter the final outcome of the patient, and most importantly, no procedure is immune to the risk of post-operative leak, which has been the main concern in performing an omental patch in larger perforations <sup>[23, 25]</sup>.

Several retrospective studies had demonstrated that peptic ulcer disease perforations larger than 2 cm have been shown to have higher leak rates (up to 15%) with primary repair, with an associated mortality of 10–35% increasing with delay in re-exploration <sup>[4, 26, 28]</sup>.

### Primary Repair with Omentopexy: (figure 2)

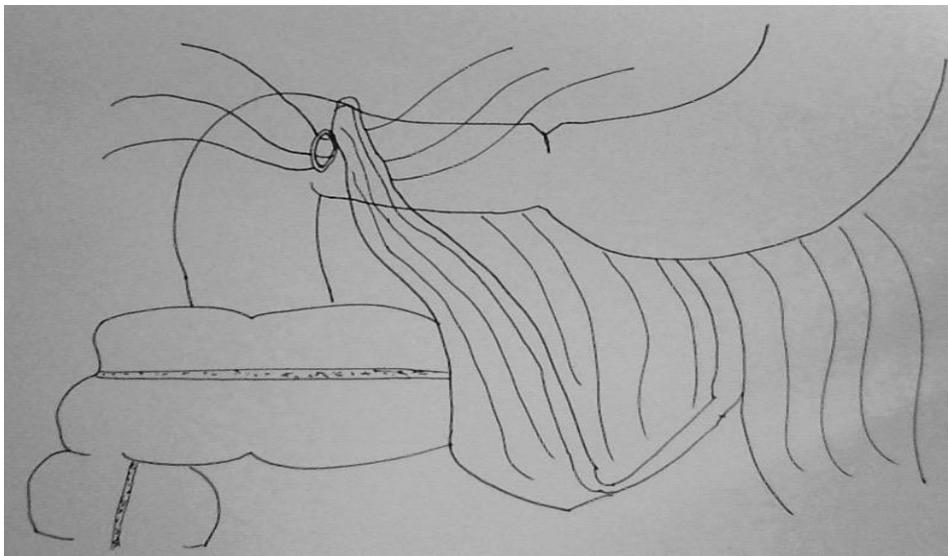


Figure 2. Omental Patch Repair



The results of omentopexy in small and large sized perforations give statistically similar results. The leak rates and mortality of the two groups after omentopexy remain comparable, suggesting that this may be considered as the procedure of choice in all perforations up to 3 cm<sup>[17]</sup>. The procedure is simple to perform, and avoids a major resection in an already compromised patient. In fact, Sharma et al also reported the success of the omental plug in perforations of duodenal ulcers more than 2.5 cm in size, but using a free graft of the omentum rather than a pedicle one<sup>[26]</sup>. However, according to Gupta et al, mobilization of the omentum on its pedicle from the colon, and placement of sutures into the normal duodenum away from the perforation makes the performance of omental patch safe even in the presence of large sized perforations<sup>[17]</sup>.

The superiority of omental plugging compared to omentopexy for perforated large duodenal ulcers was also documented by Jani et al, in a prospective randomized study of 100 patients with large-sized (> 20 mm) duodenal peptic perforation compared omental plugging with omentopexy<sup>[24]</sup>. There was no postoperative perforation site leak in the omental plugging group as compared with 6 patients in the omentopexy group. Gastric outlet obstruction was significantly less at 6 weeks and 5 years in the study group as compared with the control group and mortality was significantly less in the study group. The author concluded that omental plugging is a safe and reliable method of treatment for large-sized duodenal peptic perforations.



## The Difficult Duodenum / Complex Duodenal Injuries:

Many surgical options have been described for the “difficult to manage” duodenum.

Haemodynamic instability with a hostile abdomen is the common denominator of the patient presenting with complex duodenal injury - from trauma, giant ulcers or delayed diagnosis of perforations. Complex procedures under these circumstances, as previously described, are associated with adverse outcomes. In patients with significant comorbidities and/or haemodynamic instability, the damage control principle of trauma surgery is gaining popularity <sup>[10, 39-41]</sup>.

## Surgical Techniques Used in Duodenal Injury Management

- Jejunal serosal patching
- Roux-en-Y duodeno-jejunostomy
- pyloric exclusion and gastrojejunostomy
- pancreas preserving duodenectomy
- Whipple’s procedure
- Tube Duodenostomy
- Duodeno-jejunostomy

All of the above have been successfully utilised in these situations; however each technique has its own drawbacks when applied to this patient population.



### Jejunal Serosal Patching: (figure 3)

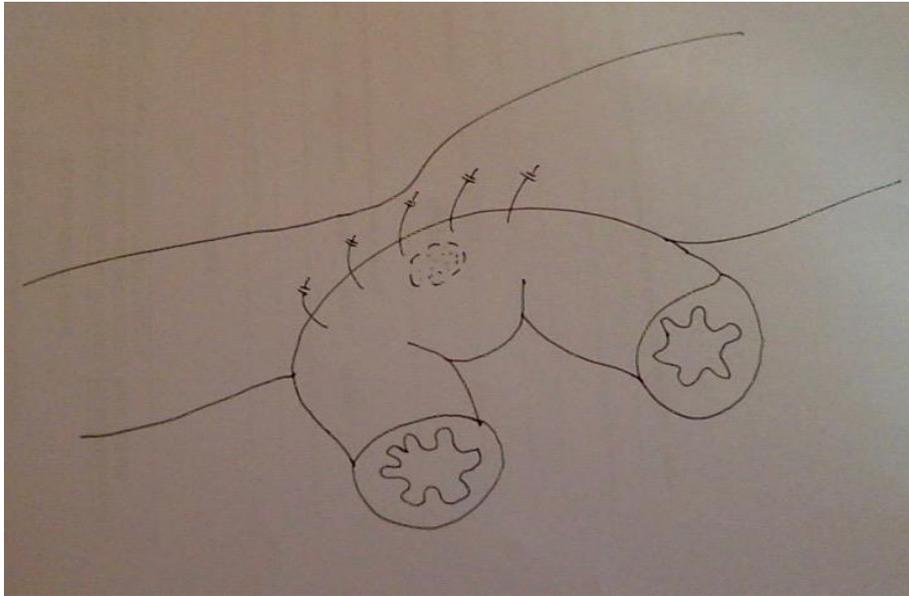
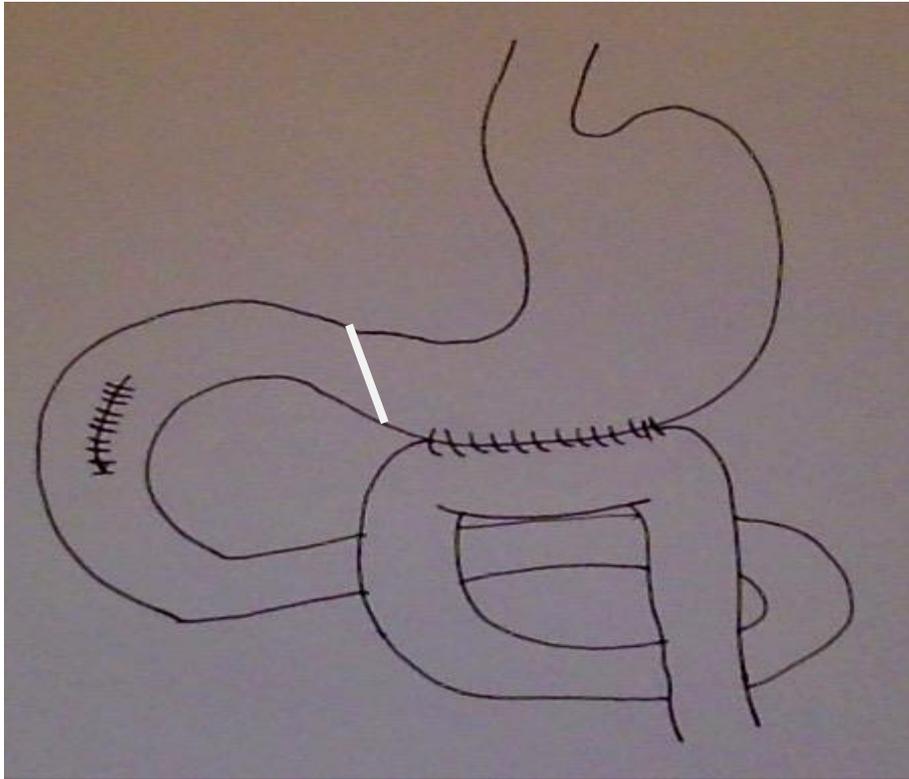


Figure 3. Jejunal serosal patch

Jejunal serosal patching is a relatively simple procedure, and is performed by suturing a loop of jejunum to cover the duodenal defect. Although this procedure has shown promising results in animal models, several series have failed to show difference in morbidity and mortality compared to primary repair<sup>[6, 42]</sup>. However, there are case reports of successful repairs of giant DU perforation with a jejunal serosal patch<sup>[43]</sup>. Similarly, Javier et al documented the first successful repair of giant DU perforation with a patch of the remnant antrum, which represents a valid alternative in similar circumstances<sup>[44]</sup>. In a recent case series, Elhelny et al successfully managed five of nine patients with primary repair and serosal patching<sup>[37]</sup>.



### Pyloric Exclusion: (figure 4)



**Figure 4. Pyloric exclusion and gastrojejunostomy**

Pyloric exclusion with primary repair has been extensively employed in the management of duodenal defects, and recent studies have noted no difference in mortality compared to primary repair <sup>[45]</sup> ; however it has also been shown to increase hospital stay without any contribution to the reduction of abdominal septic complications <sup>[46]</sup> .



## Pancreas-Preserving Duodenectomy: (figure 5)

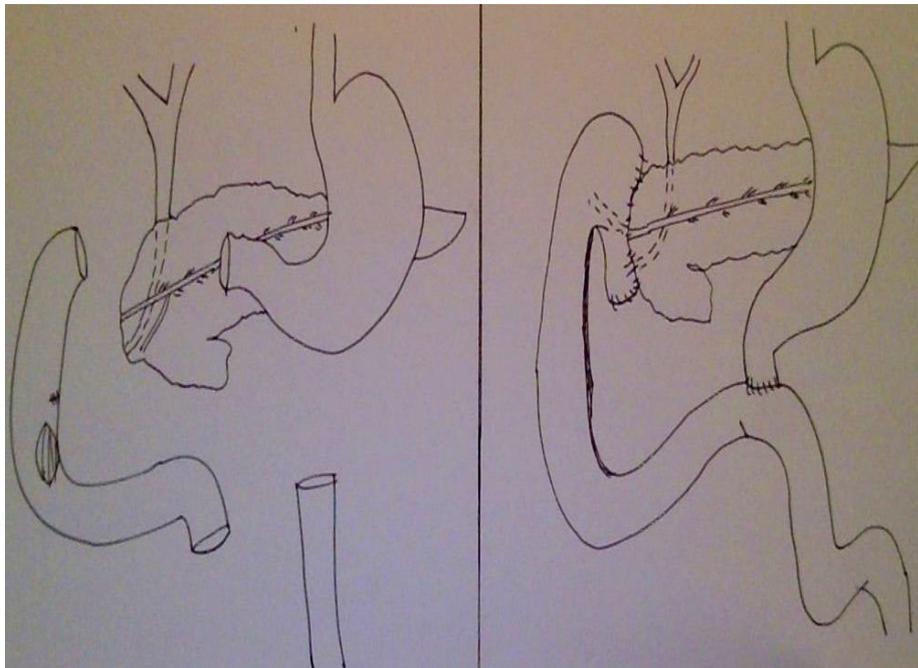


Figure 5. Pancreas-preserving duodenectomy

Pancreas-preserving duodenectomy has been advocated as an alternative to the standard Whipple's procedure in cases of complex duodenal injuries. Preservation of the pancreas, reduction in the number of anastomoses and avoidance of manipulation of the biliary tree are postulated as advantages over a standard pancreatico-duodenectomy<sup>[8]</sup>. Unfortunately, published studies comparing this procedure to the Whipple's procedure in duodenal pathology have shown no benefit in reduction of morbidity and mortality<sup>[47, 48]</sup>. Despite the relative simplicity compared to standard pancreatico-duodenectomy, a pancreas-preserving duodenectomy is still a complicated procedure which requires extensive knowledge of the anatomy and familiarity with operations in this region<sup>[49]</sup>.



## Whipple's Procedure: (figure 6)

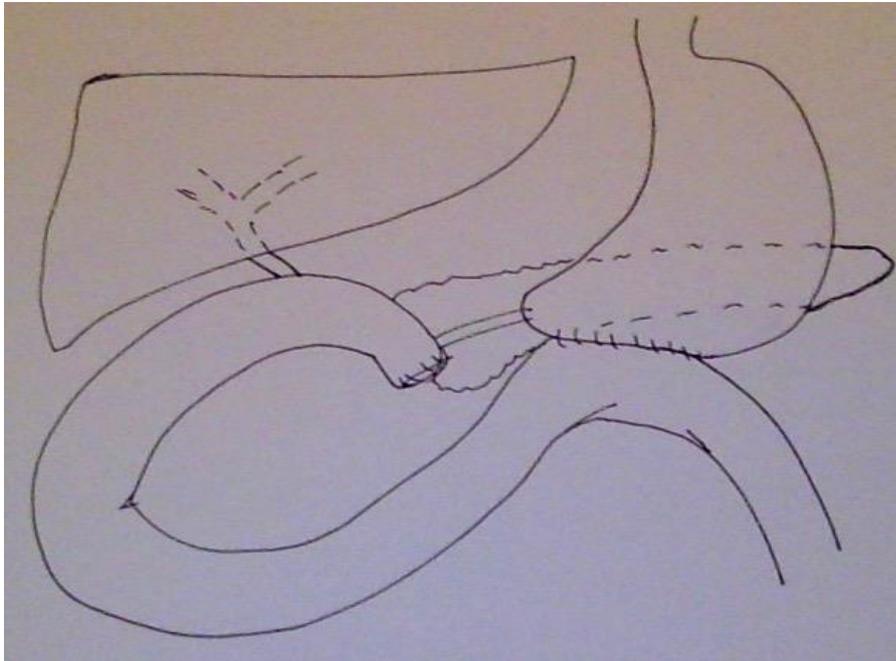
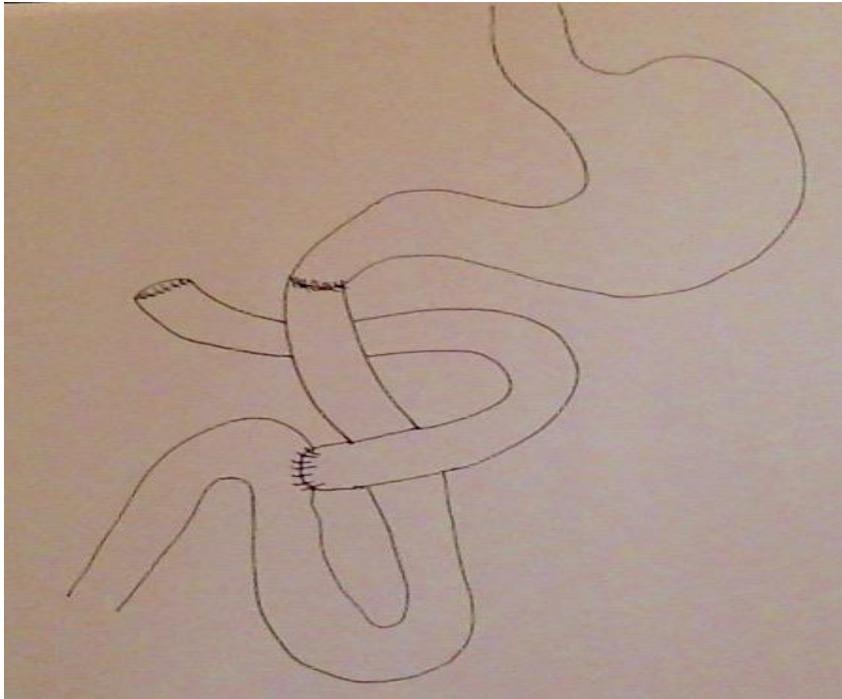


Figure 6. Whipple's procedure

The Whipple's procedure is a complex operation requiring significant experience and is prone to complications even in elective surgery. Case series published on the applicability of the Whipple's procedure to duodenal trauma have shown mortality rates ranging from 31 to 54%<sup>[30, 50]</sup>. Finally, neither a pancreas-preserving duodenectomy nor the Whipple's procedure is a feasible option in the case of the hemodynamically unstable patient.



## Roux-en-Y Duodeno-jejunostomy: (figure 7)



**Figure 7. Roux-en-Y duodenojejunostomy**

This procedure was initially defined in 1975 <sup>[5]</sup>, and has been regarded as a safe alternative to the above mentioned techniques. Although this is a well-established procedure in cases of penetrating duodenal injuries where the time to diagnosis is short, we failed to find any data regarding its use in unfavourable conditions such as delayed diagnosis, giant ulcers and especially re-leak where significant inflammation is present <sup>[51]</sup> and disseminated tumour cases where the tissue healing is grossly impaired <sup>[52]</sup>. This technique also adds another anastomosis and therefore another risk of leakage, in a patient who already has a hostile abdomen. When the size of the duodenal wall defect is so large as to prevent the application of tube duodenostomy, the successful use of duodeno-jejunostomy has been reported for the management of such defects in both trauma and tumour



invasion with success<sup>[53, 54]</sup>. Therefore, the surgeon should be prepared to perform this procedure in situations where a very large defect not amenable to tube duodenostomy is encountered.

### Tube Duodenostomy: (figure 8)

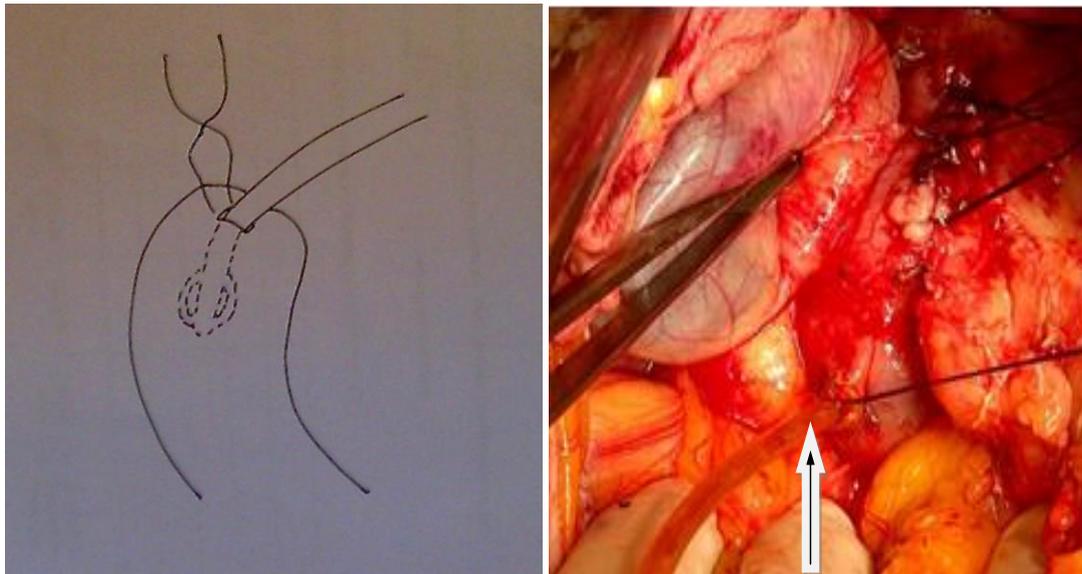


Figure 8. (a) Tube duodenostomy (diagram), (b) lateral-tubes duodenostomy (intra-op view)

The value of tube decompression of the duodenum was initially described in 1954 for the management of the duodenal stump after gastrectomy<sup>[55]</sup>. It aids in avoiding duodenal stump leak, a dreaded complication of gastrectomy operations, that in early reviews presented with a mortality rate as high as 50%<sup>[56]</sup>. Complex duodenal injuries are more prone to leaks after repair than duodenal stumps after gastrectomy. For many decades, tube duodenostomy was demonstrated as a successful method managing the difficult duodenum; however it has not gained wide popularity<sup>[57]</sup>. Although, the majority of duodenal perforations can effectively be managed by simple repair,



complicated procedures are needed for complex injuries <sup>[58]</sup>. This is also true for perforations of the duodenum due to peptic ulcer disease <sup>[17]</sup>.

It does not involve an anastomosis and is easy to learn, teach, and perform. In the early literature, several papers were published which showed no change in outcomes and high leak rates, which likely contributed to the lack of popularity for this <sup>[42, 59, 60]</sup>. Recent literature indicates excellent outcomes with no leaks, decreased morbidity and shorter hospital stays <sup>[61, 62]</sup>. In a recent study of 40 patients with giant duodenal ulcer perforations, the group who underwent tube duodenostomy had one post-operative leak compared to 14 in the conventional repair group (Cellan-Jones <sup>[65]</sup> or Graham Patch <sup>[66]</sup>) with only one case of mortality. Similar results with very favourable outcomes have been reported around the world for patients suffering trauma or a “difficult to manage duodenal stump” following surgery <sup>[63]</sup>. (figure 9)



Figure 9: Tube duodenogram at 6 weeks post op with free flow contrast through Billroth-2 anastomosis



A prospective analysis of 20 patients with giant duodenal ulcer (GDU) perforation who underwent surgery using triple tube ostomy and compared these patients with another 20 patients with GDU perforation, who were managed in the conventional manner. The success rate was 100% in the triple tube ostomy versus 30% in the control patients. Based on the ease of the technique and the high success of the procedure the author recommended this procedure for the management of GDU perforation as a safe, reliable, and easy technique to learn <sup>[15]</sup>.

### **Duodeno-jejunostomy**

This method can be applied when a complete transection of the duodenum is encountered, as was done in a recently published case by Anand et al <sup>[68]</sup>. A successful primary anastomosis was performed, and antegrade decompression tube was used, via the stomach, and a feeding jejunostomy tube was placed.

### **Comparison of different surgical techniques:**

In a recent case series in 2013, 51 consecutive patients with giant duodenal ulcer perforations were retrospectively analysed <sup>[64]</sup>. Among these patients, 18 patients were managed with omentopexy, 16 with omental plugging, 13 with triple tube duodenostomy and 4 patients with definitive surgery. However only, 13.73% patients had perforations greater than 3 cm. The mean operative time for omentopexy alone was the shortest, and the operative time for triple tube duodenostomy was significantly greater than the operative time for omental plugging. Wound infection and respiratory tract infection were the most common postoperative complications.



Similar complication rates (24%) were also reported by Hasting et al. There was no statistically significant difference in the postoperative stay among the three procedures. The mortality rate of this series was 7.84% (4 patients).

The author concluded that none of the procedures was immune to the risk of postoperative leakage, and further randomized cases should therefore be studied, using all these procedures.

## CONCLUSION:

Given the complexity of duodenal injuries and its rarity to most general surgeons, the definitive management of complex duodenal injuries should be done at a specialized hepato-pancreato-biliary centre where possible. However, amongst all the surgical options, tube duodenostomy provides an opportunity to stabilize the patient and can convert an impending catastrophe to a more controlled future surgery, where the possibility for transfer exists. It may provide a safe alternative to complex surgery in cases where sub-specialty surgeon expertise is not available.

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