

## Pancreaticojejunosomy - Risk Anastomosis after Cephalic Pancreaticoduodenectomy

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### Rezumat

#### *Pancreatico-jejunosomia - anastomoza de risc după duodenopancreatectomia cefalică*

**Introducere:** Autorii aduc în discuție anastomoza pancreatico-jejunală (APJ) după duodenopancreatectomia cefalică (DPC). Este o anastomoză consacrată pentru riscul mare de complicații. Printre aceste complicații, fistula pancreatică (FP) se distinge printr-o frecvență notabilă, în medie 10%. Este poate cea mai nesigură anastomoză din chirurgia digestivă, aceasta datorită partenerului pancreatic. Realizarea unei APJ etanșe poate fi considerată o performanță: se pun în contact un lumen digestiv cu o structură parenchimatooasă friabilă, centrată de un canal excretor delicat, rareori anastomozabil el însuși.

**Material și metodă:** Au fost studiate două loturi distincte de pacienți supuși DPC. Un prim lot – 58 cazuri operate în perioada 1967 – 1983 și un al doilea lot – 70 cazuri operate în perioada 1984 – 2013. În toate cazurile s-a practicat APJ; pe ansa în continuitate în primul lot și pe ansa separată la lotul al doilea. În cel de al doilea lot s-a utilizat o variantă tehnică proprie care să nu permită deperdițiile anastomotice de suc pancreatic. S-a înregistrat astfel o scădere a incidenței FP de la 20% la 8%, ultimul procent aparținând lotului doi. La cei 8% pacienți cu FP deperdițiile au fost pur pancreatice, nepoluate biliar și nici alimentar. Stentarea anastomozelor bilio și pancreatico-jejunale a fost constatată pentru pacienții lotului doi.

**Discuții:** Procentul de FP după DPC nu a înregistrat vreun revirement notabil dacă vom compara perioada anilor 1980 cu cea actuală. Totodată, mortalitatea datorată FP se apropie de 40%, cifra descurajantă. Multitudinea de variante tehnice pentru restabilirea tranzitelor după DPC, peste 80 de procedee, vine să confirme nesiguranța și neîncrederea în APJ. Autorii propun câteva gesturi chirurgicale, adresate APJ, gesturi capabile să asigure un procent de 8% FP, procent considerat de către noi ca fiind rezonabil.

**Concluzii:** Autorii consideră stentarea APJ ca fiind obligatorie. Plasarea APJ izolată pe ramura scurtă a „Y”-ului, în afara tranzitului bilio-alimentar, împiedică constituirea unei fistule complexe. Tehnica propusă nu presupune o APJ tip „duct – to – mucosa” sau tip „telescopare” pancreato-jejunală.

**Cuvinte cheie:** anastomoza pancreatico-jejunală, duodenopancreatectomia cefalică, fistula pancreatică

### Abstract

**Introduction:** The authors bring to attention pancreaticojejunal anastomosis (PJA) performed after cephalic pancreaticoduodenectomy (CPD). This type of anastomosis is renowned for its high risk of complications. Among these complications, pancreatic fistula (PF) is distinguishable due to a significant frequency, averaging 10%. It is perhaps the most unsafe type of anastomosis in digestive surgery, due to its pancreatic partnership. Performing a sealed APJ can be considered a great achievement: a digestive lumen is set in contact with a brittle parenchymal structure, centred by a delicate excretory channel, difficult to anastomose in itself.

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**Material and methods:** We studied two distinct groups of patients undergoing CPD. A first group - 58 cases operated on between 1967 and 1983, and the second one - 70 cases operated on between 1984 - 2013. In all cases we performed PJA; by in-continuity loop technique in the first group, and with separate loop in the second group. In the second group we used a variant own technique that does not allow anastomotic loss of pancreatic fluid. Thus, a decline in the incidence of PF from 20% to 8% was obtained, the final percentage corresponding to group two. Of the 8% of patients with PF losses were recorded strictly at pancreatic level, with no bile or food contamination. Stenting was recorded for biliary- and pancreaticojejunal anastomoses in group two.

**Discussions:** The percentage of PF after CPD did not show any notable revival when comparing the 1980s period to the present. Also, mortality due to FP is approaching 40%, a daunting figure. The multitude of technical options for restoring bowel movement after CPD, over 80 procedures, further confirms the lack of safety and trust in relation to PJA. The authors bring forward several surgical gestures addressing PJA, gestures capable of providing an 8% frequency of PF, percentage which we consider to be reasonable.

**Conclusions:** The authors consider PJA stenting mandatory. Placing an isolated PJA on the short branch of the "Y", separate from the biliary and food flow, prevents the formation of a complex fistula. The proposed technique does not require a "duct - to - mucosa" type or "telescoping" type pancreaticojejunal anastomosis.

**Key words:** pancreaticojejunostomy, cephalic pancreaticoduodenectomy, pancreatic fistula

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## Introduction

Pancreatic fistula (PF) is the most common postoperative complication after cephalic pancreaticoduodenectomy (CPD). PF frequency is between 2% and 24%, triggering its own specific mortality, of 9-25%. This wide range of PF rate, as well as that of deaths attributable to it, can be explained by several factors: the quality and calibre of the remaining pancreatic stump and the calibre of Wirsung's duct (different for chronic pancreatitis compared to periampullary neoplasms), the treatment method of the pancreatic stump (abandonment after Wirsungian obturation or anastomosis to the jejunum / stomach), pancreatic-digestive anastomosis with or without a prosthesis. PF can be completely avoided in only one way: total pancreatectomy. Most surgeons do not resort however to this overly-radical solution, as it is accompanied by disability requiring complex therapies, difficult to control and manage.

Successful completion of the resection step of CPD does not ensure certainty of favourable development. Restoring transit requires three anastomoses, the most unsafe being that in pancreatic partnership. Performing these anastomoses "in a

series", one after another, on the same jejunal loop, regardless of their sequence, creates favourable conditions for "contamination" with both bile and food of the pancreatic fistula at the time of its occurrence. A complex fistula, not just a pure pancreatic fistula is in fact developed. Discharge into the peritoneum of pancreatic, biliary, and gastric secretion, including ingested food, will have a devastating effect on the tissues. It creates the conditions necessary for the installation of sepsis, with all its forms of local and general manifestation. Surgical concern was intense and constant in relation to lowering the rate of fistular complications. This concern is reflected in the large number of proposed solutions to prevent fistulas after CPD. Thus, over a period of just 7 years, between 1942-1948, approximately 80 anastomotic techniques were investigated, out of the desire to avoid fistular complications.

Surgeons from the above-mentioned historical period had to correct three major targets. First of all, to eliminate the gallbladder as biliary anastomotic biliary, meaning essentially to perform gall-bladder ablation during the resection step as a principle. All "historical" procedures ignored the gallbladder, leaving it in place, and some used it as a biliary tree anastomotic partner. Ascendant angiocholitis and vesicular septic processes constituted a major risk of this biliary-digestive derivation. Whipple, Child, Mallet-Guy, Orr, Phillips, among the most active in the field at that time, each proposed their own variations on the same theme. It is worth mentioning that out of over 80 proposed techniques at that time, only 2 involve removing the gallbladder - Hunt (1941) and Phillips (1943) - thus eliminating vesicular complications and poor biliary-digestive drainage (quoted by 1).

Secondly, the "omega" loop, with or without Braun fistula was often used as the digestive receiver. This is because the resection of the duodenum stopped at DIII, its tranche being sutured. Resection did not advance to the Treitz angle. The surgeon had to ascend an omega loop with a point fixed to the duodeno-jejunal angle. Pancreaticoduodenal resection was insufficient to the left and the duodenal stump was also responsible for additional fistular risk. On the omega loop or on a loop in-continuity, when resecting under the Treitz angle, the operator successively unfolds the three segments remaining after visceral resection, performing successive anastomoses with the stomach, pancreas and bile ducts. The results are known - mortality from 25% to 40%, in the circumstances of installation of complex fistulae in 20-30% of cases. This reality was daunting.

Finally, thirdly to be resolved remained the treatment method of the pancreatic stump, the most sensitive issue of CPD. Also in the mentioned period, surgeons resorted to anastomosis of the jejunum or suture of the pancreatic stump. They recorded fistulas in approximately 1/3 of patients operated. From then until today, the situation has changed to some extent. In the 1980s, operative mortality ranged between 12% and 20%, with 7-33% PF (1, 2). A decrease in mortality compared to the 4th decade of the same century is observed, but PF frequency is similar. A recent study of our time, a multicentric meta-analysis investigated postoperative mortality, which ranged from 7-14% depending on the number of CPDs

conducted in various hospitals (3). It turns out that the last 30 years have not distinguished themselves through notable decrease in mortality, and PF remains at a rate of 14-22% (4,5,6). All ways of performing pancreatico-jejunal and pancreatico-gastric anastomosis were attempted. The conclusion drawn from this was that the remaining pancreas is unpredictable enough to create unpleasant surprises in the postoperative period.

### Aim of the study

We were interested in determining whether there is room for corrections in pancreatico-jejunal anastomosis (PJA), in order to reduce the risk of PF. Our interest is older and is based on experience gained by Prof. Dr. Burlui as chief of the Surgery Clinic of Caritas Hospital (Bucharest). Over the period 1967-1983 in the clinic mentioned above 58 CPD were performed, using a wide range of variants of pancreatico-jejunal assemblies, all however performed on the same in-continuity jejunal loop, with sequential gastrointestinal and biliary-jejunal anastomosis. We note that one nearly constant specific complication of CPD was PF heavily contaminated by food and bile, which occurred in 20% of cases.

Since 1984 until present performing all 3 anastomoses on the same loop has fallen out of practice. PJA was performed separately on the short branch of the "Y" loop, according to the principles promoted by Chapuis, Machado, Kingsnorth (1,2,7).

All transit continuity recovery processes have at least two intentions:

- To prevent ascending angiocholitis, which involves placing the gastric derivation downstream and at a distance from the biliary-jejunal anastomosis, about 30 cm inferior to the latter.
- To prevent the installation of PF, and if it occurs, to ensure that it is a "pure" fistula, uncontaminated by food and bile.

The aim of the study is to provide a safer version of PJA, based on clinical experience in this field.

### Material and Method

We studied a group of 128 CPD performed for the treatment of periampullary neoplasms (88%) and that of pseudotumoral chronic pancreatitis (12%). This group could be divided into 2 subgroups:

Group I: 1967-1983: 58 cases

Group II: 1984-2013: 70 cases

These groups differ radically one from another in the treatment method of the pancreatic stump. In the first period (group I), a wide variety of anastomotic construction assemblies was used, with omega or in-continuity jejunal loop. The common denominator of these assemblies is that all anastomoses were placed successively on the jejunal loop, one after another, differing only in order of succession (Figs. 1, 2). Thus, by Mallet-Guy and Orr processes, regardless of the sequence of execution of the assemblies, the results were: the PF allowed food and biliary contamination by Orr version, and by the Mallet-Guy variant only the risk of biliary contamination of

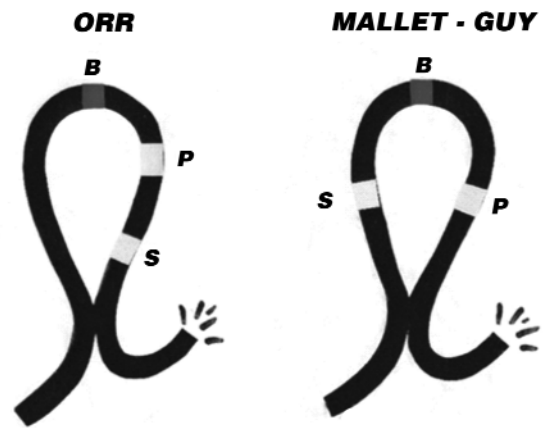


Figure 1. Sketch of the assemblies on the omega loop. Placement of the anastomoses in the series: S – gastric, P – pancreatic, B – biliary



Figure 2. Sketch of the assemblies on the in-continuity loop S – gastric, P – pancreatic, B – biliary

the PF remained. Both assemblies set the scene for ascending angiocholitis. After rapidly receding from the omega loop, use of in-continuity or Y loop was resorted to, due to the fact that uncrossing of the duodenum and Treitz angle resection as part of the CPD was performed as a principle. All 3 series anastomoses succeed one another on this jejunal loop, in variants known and described by Whipple, Brunschwig and Child (Fig. 3). This type of assemblage has not provided the expected results either. PJA continues to be "bathed" in bile secretions and food debris, whichever the sequence of anastomoses. Once installed, the PF became the point of discharge of the biliary-food complex, with associated related local sepsis. By 1984 58 CPDs, with anastomoses on the same loop, were performed. We have not found any difference between the results according to the order of the anastomoses. PF continued to develop in 20% of cases, which is a very high percentage. In addition, this type of complex fistula care is very difficult: local suppuration, self-digestion tissue, bleeding from the wound, skin digestion with eviscerations more or less blocked, and manifested sepsis. All together lead to a rapid and marked degradation of the biological status, severe septic malnutrition and progression to exitus.

Analysing the second group (1984-2013), it can be



**Whipple 1946**

**Figure 3.** Whipple – Child procedure

evaluated as homogeneous, meaning that the pancreatic assemblage was always performed on a separate pancreatic loop, isolated, namely on the left branch of a Y loop (a la Roux).

#### *Pancreaticojejunal anastomosis technique*

Starting from the pancreaticojejunostomy method on a separate loop proposed by Machado and Chapuis (1.2), we have brought a number of changes to this technique. We wish to emphasize from the very start the decisive importance attributed to the quality of the pancreatic stump to be anastomosed. A pancreas with an obvious fibrous component would be a safer anastomotic partner. The normal pancreas does not present a resistance structure favourable for passing and knotting suture wires. It can be said that the pancreas has an improper tissue structure to be used for a safe anastomotic suture: well vascularized organ, with usually poor fibro-connective tissue, with a brittle acinar structure and intense proteolytic activity. The sum of these pancreatic features is responsible for its vulnerability as an anastomotic partner. To these a 2-3 mm calibre Wirsung duct, and a very thin and frail wall, lacking suture resistance, are frequently added. Another series of "lacks" attributable to the pancreas reflect on PJA. The result is the most unsafe anastomosis of digestive surgery. We believe in mandatory gestures in relation to pancreatic transection during resection:

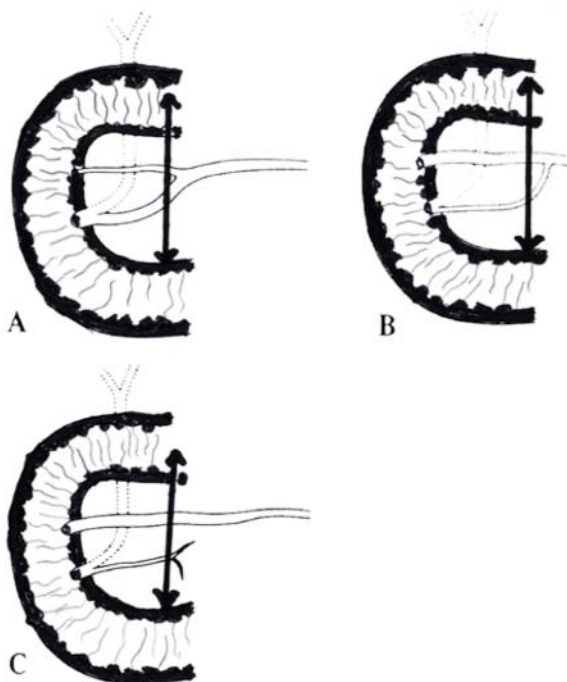
- "Cold" section of the pancreatic tissue, instead of using an electric scalpel;
- Avoiding electrical or thermal haemostasis of the pancreatic tissue;
- Transection immediately left from the porto-mesenteric axis;
- Compulsory removal of the retroportal blade.

"Cold" section of the pancreas - we had major dissatisfaction when we used an electric scalpel for the dissection of the pancreas. A thermal burn on the tranche, with destruction of

acinar conglomerates, was determined, further onset trigger of acute pancreatitis of the pancreatic stump, in its worst forms. We gave up this type of pancreatic sectioning quickly. The scalpel blade obviously leads to an active bleeding, but never determined the inconveniences of stump pancreatitis.

Avoiding electric haemostasis - it is recommended that bleeding from the pancreatic section tranche be controlled by placing a Halsted type fine forceps, followed by wire ligatures. The reasoning is simple: thermo-electric aggression destroys pancreatic acini and triggers pancreas self-digestion.

Transection immediately left from the porto-mesenteric axis: to ensure removal of the pancreatic area drained by the Santorini ductal system it is necessary to place the pancreas section left from the portal axis, not in front of it. Anatomy shows that in some patients, dissection next to the pancreatic "neck" can leave open the origin of the Santorini duct and part of the pancreatic tissue drained by it. In this situation we will most surely register a pancreatic stump fistula, due to the initial portion of the Santorini duct. In the figures herewith, illustrating variations in pancreatic ductal dispositions, one can observe that the pancreatic sections on the portal axis can lead to intraoperative fistulas in the Santorini territory (Fig. 4). Simultaneously, the surgeon must remove the retroportal pancreatic blade. This can be more or less represented, and is sometimes missing. When more consistent, it is in relation with the origin of the superior mesenteric artery, below which it may extend. It can have its own arterial sources and venous drainage. Abandoning this pancreatic blade can also be a source of immediate drawbacks: pancreatic fistulas, retroperi-



**Figure 4.** Pancreatic duct disposition mode variants: A - Usual type, B - Santorini duct as the major duct, C - Santorini duct completely disconnected, accessory Wirsung duct. Pancreatic section level in CPD (↔)



toneal collections (8).

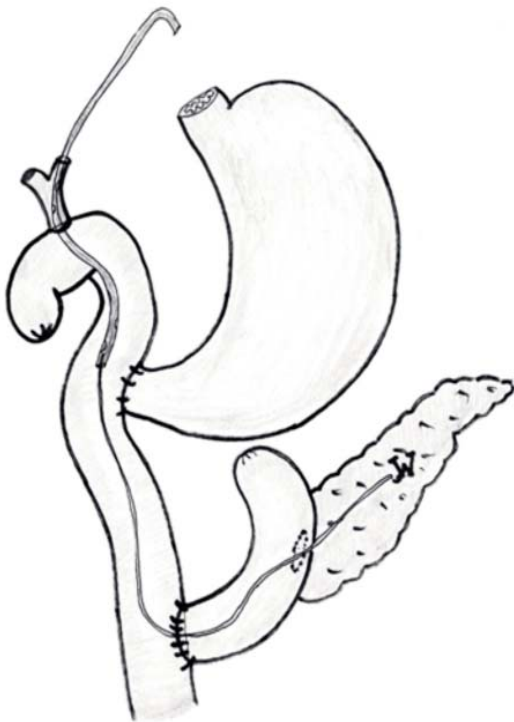
Modern prospective studies have concluded that there are no significant differences regarding PJA postoperative morbidity and pancreaticogastric derivation. Both have a similar rate of PF (9,10,11).

Returning to PJA, we recorded a variety of technical choices, especially depending on four coordinates:

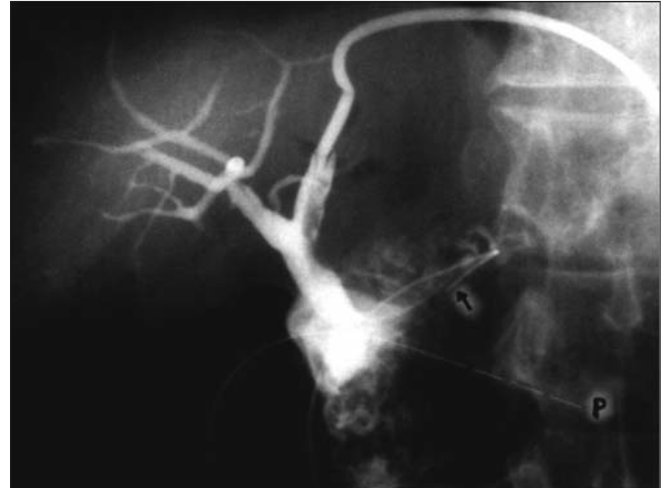
- Anastomosis "duct-to-mucosa" (7);
- Telescoping the pancreas in the receiver jejunal loop (9,11,29);
- Separate anastomosis on a Y loop (left branch of the Roux loop) (1,2);
- Stenting or non-stenting of the PJA (12,13).

The combination of these 4 points of surgical interest gave rise to a wide range of "saving variants" and "safe solutions" in relation to PJA. If we look at the significant groups, abscesses and fistulas are found in 20-25% of cases. A fistula is defined as a loss greater than 50 ml / 24h via the drain tube, the liquid presenting amylase content at least 5-fold higher than blood levels (14, 15, 16).

We adopt a more flexible attitude on APJ, meaning that the "duct-to-mucosa" principle often cannot be met, given the improper Wirsungian calibre of an anastomosis. Also, we do not convey much trust to the resistance to suture of the remaining pancreatic tissue, regardless of the degree of fibrosis, more or less expressed. In essence, the left branch of the jejunal Y will take on the pancreatic stump in a terminal manner for the pancreas and lateral for the jejunum. Protecting the anastomosis is mandatory for us and a drain tube will be attached to



**Figure 5.** Sketch of personal procedure on isolated Y loop. Biliary and pancreatico-jejunal anastomosis with prosthesis



**Figure 6.** Postoperative cholangiography image of the personal procedure: P - transanastomotic Wirsungian stent (->) joined with the drain tube of the biliary-jejunal anastomosis, externalized transhepatoparietally

the axial external biliary drainage (Fig. 5). Note that the pancreatic drain will be sealed on the Wirsungian stump by a pericanalar wire passed in the bursa. This way there are no losses of pancreatic juice beside the stent, stent which will fully take over all outstanding exocrine secretion and transfer it to the anastomotic loop. A similar bursa wire will seal the jejunal bursa around the stent (Fig. 6). Then, the two anastomotic partners will be set in apposition through separate wires passed between the pancreatic parenchyma and the jejunal loop. In this manner, the anastomotic stent will take over all the remaining pancreas secretion and lead it into the jejunal receiver, without risk of peritubular loss.

This manner of proceeding has been applied starting with 1984 to 70% of cases. A percentage of 8% (11 cases) PF was recorded, a notable decrease comparing to the present rate of the other group in our study. In addition, PF from the second period analysed had a low complexity and severity degree. All were "pure fistulas", uncontaminated by bile or food. Oral nutrition was possible and advisable, which is not allowed in case of a PF presenting biliary or food transit, or in case of a fistula developed on a pancreatic-gastric anastomosis. We mention that all these fistulas presented reasonable daily flow, without exceeding 100 ml evacuated via the juxta-anastomotic drain. A "drying of the fistula" was obtained conservatively, and since the introduction of the octreotide healing was achieved in 20 days. We also recorded pseudocysts in 3 patients who developed a PF. In 2 cases surgical drainage of the pseudocysts was required, the remaining one being reabsorbed within approximately four months.

## Discussions

Postoperative mortality and morbidity after CPD remain almost unchanged after 30 years - 0-21% operative mortality in the 1980s, compared to 0-20% in 2010 (1,2,17,18). For the same periods compared, frequency of PF was between 6-20% in

the first period and 3-15% in the second period, according to the authors cited above and to others as well (19,20,21,22). Hence the idea that improvement in risk of PF has not recorded a notable turnaround, technical artifices and changes brought to the anastomosis to the pancreatic stump however not rising to expectations. Pancreaticogastric anastomosis included, initially a great hope, proved to be accompanied by the same rate of PF. Also, mortality due to PF approaches 40%, a figure downright daunting (4,23,24,25). Postoperative morbidity specific to CPD, according to experienced authors, is between 18-60% (6,9,24,25). Average length of stay is between 15 and 24 days, but with maximums reaching up to 239 days (4). Hence the existence of a multitude of postsurgical complications, among which most important are those PJA dependent, as shown in the literature covering CPD. Going through medical journals, we find different definitions and names for the same complication. Thus, we meet the terms of fistula, anastomotic disunion, pancreatic loss. In fact, all this terminology refers to the same complication - leaks and lack of integrity of the PJA. To prevent all these inconveniences related to PJA, several technical variants were used: duct-to-mucosa, dual-layer anastomosis, jejunal intubation of the pancreatic stump, anastomotic stenting (19,20,22,26,27,28). None of the variants used managed to convince. More recently, a number of authors published their statistics and provided quite exceptional results: 0-15% fistulas from PJA (21, 28,29). Unfortunately, they do not provide convincing arguments regarding to which surgical approaches is the success of PJA due in their statistics.

For the surgeon one fact is clear: anastomoses with the pancreas are the most unsure of all digestive surgery, as evidenced by the high percentage of fistulas compared to other digestive anastomoses. With an acinar structure similar to that of the salivary glands, the pancreas is poor in connective tissue, provides a low resistance to suture and produces a set of proteolytic enzymes without equal. In addition, the Wirsung duct is usually frail, with a very thin wall, calibre of 2-4mm, improper for a safe anastomosis. We cannot improve the qualities of this organ, in that of density and increased resistance to suture at the time of anastomosis. To compensate for the defects of PJA attributable to the pancreatic stump, we can take, however, precautionary measures to reduce the chances of fistulisation and reduce the magnitude and complexity of the fistula, when it develops. Stenting is the prophylactic solution for PF and was highly promoted in the sense that this gesture must conclude any PJA, regardless of the technique variant used: isolated loop, duct-to-mucosa, jejunal invagination of the pancreas. We prefer the PJA technique on separate loop to prevent a complex fistula contaminated by food and bile, as in the case of PJA by incontinuity loop. "Pure" pancreatic fistulas are the most "benign", most easy to care, and with highest chances of conservative healing. Pancreaticogastrostomy due to Waugh (1946) and Park (1967) has the great disadvantage that it can be followed by a complex fistula - pancreatic fluid, gastric fluid and possibly food.

PJA on separate loop is gaining increasingly more

upholders. Introduced by DeMachado in 1976, it expanded through the endeavours of Ligidakis (1985), Funovics (1987) and Kingsnorth (1997). Associating stenting for this type of anastomosis, we provide further prevention of PF and, especially, offer the chance of a pure pancreatic, controlled fistula, given that natural feeding is allowed and even indicated.

## Conclusions

1. The pancreas is the most precarious anastomotic partner of all digestive surgery.
2. Pancreatico-jejunal end-to-side anastomosis on separate loop allows isolating fistular risk only at the level of the pancreas, avoiding the risk of biliary and gastric losses.
3. Temporary Wirsung-jejunal and biliary-jejunal stenting seals these anastomoses.
4. It is a considerable advantage to treat a pure pancreatic fistula, and not a complex one.
5. Oral feeding is possible and appropriate, even if a pancreatic fistula develops.

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