THE ‘TRIANGLE OPERATION’ APPLIED IN A CASE OF PANCREATICODUODENECTOMY

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ABSTRACT

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Introduction
A novel technique for more radical resection of the soft, nerve, connecting tissue and lymphatics to reduce the local recurrence of pancreatic cancer and potentially to improve survival was described in 2017. This resection does not refer to a more extended lymphadenectomy technique but rather to a more radical dissection of the tissue confounded by the celiac axis, the superior mesenteric artery and portal vein. However, the increased morbidity associated to this technique may be the reason for not being used as a standard procedure in all the pancreatic resections for malignant disease, either in the setting of primary surgical treatment or after the neoadjuvant chemotherapy one.
Aim
To present the case of a patient treated by pancreaticoduodenectomy for a head pancreas tumor, in whom a more radical clearance of the soft tissue surrounding the regional vascular structures was performed.
Material and Methods
A retrospective review of a prospective database that included all the pancreaticoduodenectomies performed between 2018 to 2024 at a single surgical department were performed.
Results
A case of a single patient was identified. A 71-year-old female of BMI 26 was offered a pancreaticoduodenectomy for head of pancreas tumor, with a more radical resection of all the tissue contained in the triangle bounded by the celiac axis, superior mesenteric artery and portal vein being removed. The operation time was nine hours, the ICU stay was two days, and the hospital stay was 26 days. The morbidity of the patient included post-operative bleeding managed conservatively.
Conclusions
The TRIANGLE operation for pancreatic resections is a type of operation different than the standard pancreaticoduodenectomy. However, this technique may be associated with increased morbidity. There is no consensus for introducing this technique for all the pancreatic resections for malignancy. The results of a systematic review and metanalysis of a published protocol regarding safety and efficacy of this procedure are awaited.

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INTRODUCTION

Pancreatic cancer has a dismal prognosis with a 5-year-survival rate of about 5%. Patients with resectable disease followed by adjuvant chemotherapy can achieve longer survival. Neoadjuvant chemotherapy has been established as the appropriate strategy for the borderline resectable or locally advanced tumors.

However, the local recurrence of the disease is a usual phenomenon, and this is a key factor contributing to the dismal prognosis of this disease. The medial resection margin along the SMA is the most frequent site of incomplete tumor clearance. This margin is included in an area called ‘the mesopancreas’. This is a vascularized structure composed of fatty tissue, the nerve plexus, and lymph nodes located in the pancreatic retroperitoneal region between the pancreatic head and superior mesenteric and celiac vessels.

Different surgical techniques to facilitate increased surgical radicality of this area have been described. Though arterial vascular resections is an option for cases with advanced disease, it is not commonly performed due to its high complication rate and even the risk for mortality. Periarterial and sub-adventitial divestment of the SMA are alternatives methods, and more recently the technique of the “TRIANGLE Operation” have been described.
The Heidelberg group described this technique in 2017, suggesting a complete removal of all the tissue that is included in the triangular area bounded by the Celiac axis, the SMA and the mesenteric-portal axis.

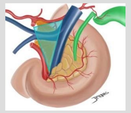


fig.1 Posterior view of the TRIANGLE operation (1)

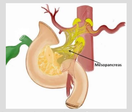


fig.2 Anatomic location of the ‘mesopancreas’ (2)

METHODS AND MATERIALS

We aimed to present the case of a patient treated by pancreaticoduodenectomy for a head pancreas tumor, in whom a more radical clearance of the soft tissue surrounding the regional vascular structures was performed. A literature review regarding the Triangle operation was also performed

A retrospective review of a prospective database that included all the pancreaticoduodenectomies performed between 2019 to 2024 in our department was performed.
During this period, 71 pancreatectomies were performed that included 60 pancreateticoduodenectomies.
Though we practice our standard technique of lymphadenectomy and extend of tissue resection at the high-risk region for disease recurrence, namely the SMA margin, we identified one case where a patient undergone the so called ‘TRIANGLE’ operation.

RESULTS

A 71-year-old female, diabetic patient with a BMI of 26 was offered a pancraticoduodenectomy for a head of a pancreas tumor, that was previously causing obstructive jaundice. The obstruction was due to a lesion at the head of the pancreas that was drained by ERCP and stenting. As the tumor was deemed resectable we proceeded to surgery without EUS and tissue biopsy.

This is the only case of pancreaticoduodenectomy where a more radical resection of all the tissue contained in the triangle bounded by the celiac axis, superior mesenteric artery and portal vein being resected.
Based on pre-operative axial imaging, we noticed a prominent peri-pancreatic lymphadenopathy as well as abnormal tissues surrounding the SMA or origin of celiac trunk that were not in continuation of the main pancreatic head lesion.

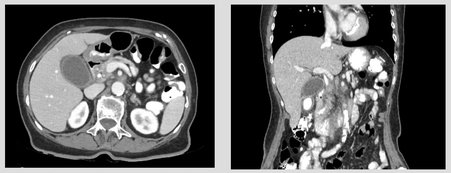
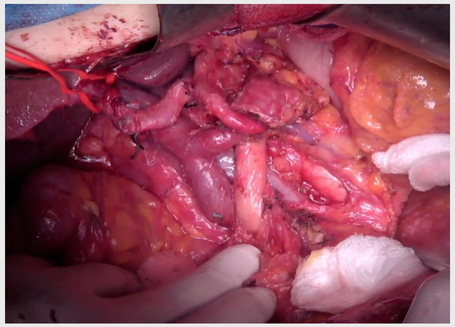


fig.3-4 Axial imaging revealing subnormal tissue surrounding the origin of arterial structures



RESULTS

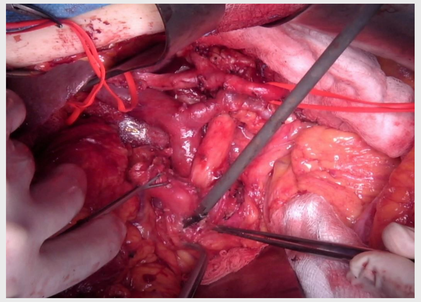
Though we don’t routinely dissect the tissues at the origin of the celeiac trunk or the SMA origin neither we skeletonize the SMA , in this case we proceeded to a circular (360 degree) resection of all the lymph and nerve plexus around the superior mesenteric artery. Performing this led to a circular dissection around the SMV, and finally all the tissue contained in the TRIANGLE between the CA, SMA and MPA were removed.

The operation lasted nine hours without any intra-operative complication. Due to an atrophic remnant pancreas, we changed our routine practice for pancreatic anastomosis to a pancreatico-gastrostomy.

The post-operative ICU stay was two days. On the 4th postoperative day, we noticed a drop of Hb, with serous-sanguineous fluid draining via the abdominal drains. The patient was mildly tachycardic without any drop in blood pressure. We proceeded to an investigation of a possible abdominal bleeding, and a CT-angiogram revealed a 14x6cm hematoma on the right upper quadrant extending to the laterally. Furthermore, the abdominal DSAngiogram did not prove any acting bleeding.
LMWH was on hold for 3days and the patient was transfused with overall 4 units of RBCs. She was discharged on the 28th post-operative day.

The final histology revealed a pancreatic adenocarcinoma(grade I) on the background of an IPMN. The total number of LN harvested was 48, and 29 were infiltrated by malignant cells. Perineural and lympho-vascular infiltrations were also noted.

The patient received adjuvant chemotherapy and she is alive without evidence of disease recurrence 14 months after the operation.



DISCUSSION

Local recuurence occurs in 25-45% of patients following surgical resection for pancreatic adenocarcinoma. Resection margin status and completeness of resection are strong predictors of overall survival. (4) Unlike other tumors, PDAC has a distinctive propensity for perineural invasion, and thus tumor spread alongside the arterial structures is possible.

Different approaches of pancreaticoduodenectomy, especially when it comes to borderline resectable or locally advanced tumors, have been described in order to achieve complete clearance of the disease. In an attempt to remove all the tissue including fatty tissue, the nerve plexus, and lymph nodes located in the pancreatic retroperitoneal region between the pancreatic head and superior mesenteric and celiac vessels, the concept of ‘mesopancreas’ excision was introduced since 2012. (5)

Triangle operation has been described as the specific approach for this purpose, initially after neoadjuvant treatment to spare the need for an arterial resection, but it can be performed in upfront surgery for pancreatic cancer. (6) This operation is not a type of extended lyphadenectomy, it is just focusing on the site of the ‘hot spots’ of frequent local recurrence. (7)

Complications of this particular technique are the well-known ones of pancreatectomies. But whether bleeding and post-operative diarrhea are of higher incidence after this operation it remains to be elucidate. There are only few publications covering this topic, and most of them include patients after neo-adjuvant chemotherapy undergoing total pancreatectomy. (8)
The results of a recent published protocol for a systematic review and meta-analysis will hopefully give us enough information in order to justify the adaptation of this technique. (7)

CONCLUSIONS

The TRIANGLE operation is a technique used in pancreatic surgery in order to improve R0-resection rates and consequently reduce local recurrence and possibly overall survival.
There is limited evidence to suggest that this operation should be adopted for all the pancreatectomies.
We do not think that pancreatoduodenectomy according to the TRIANGLE protocol can be performed without increased morbidity and mortality, since the evidence for this come from observational studies including small number of cases.
Long-term survival and quality of life need to be investigated in prospective clinical trials with adequate sample size.

REFERENCES

1. Eduardo de Souza M. Fernandes, Oliver Strobel,Camila Girão,Jose Maria A. Moraes-Junior, Orlando Jorge M. Torres. What do surgeons need to know about mesopancreas. Langenbeck's Archives of Surgery, https://doi.org/10.1007/s00423-021-02211-y
2. Thilo Hacket et al. The TRIANGLE operation –radical surgery after neoadjuvant treatment of advanced pancreatic cancer: a single arm observational study, HPB 2017, 19, 1001-1007
3. Adham M, Singhirunnusorn J. (2012) Surgical technique and results of total mesopancreas excision (TMpE) in pancreatic tumors. Eur J Surg Oncol 38:340–345.
4. Strobel O et al (2017) Pancreatic cancer surgery: The new R-status counts. Ann Surg 265(3):565-573
5. Adham M, Singhirunnusorn J. (2012) Surgical technique and results of total mesopancreas excision (TMpE) in pancreatic tumors. Eur J Surg Oncol 38:340-345
6. Klotz R, Hacket T, HegerP, et al. The TRIANGLE operation for pancreatic head and body cancers: early postoperative outcomes. HPB 2022;24:332-41
7. Wei K, et al. Safety and efficacy of TRIANGLE operation applied in pancreatic surgery: a protocol of the systemic review and meta-analysis. BMJ Open 2022; 12:e059977
8. *Shuyu Zhai, et al. TRIANGLE operation for borderline resctable pancreatic cancer in total pancreatectomy. Transl Cancer Res* 2019;8(6):2416-2424