



Paraganglioma in a teenage boy – A role for aggressive surgery[☆]

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ABSTRACT

Abdominal paraganglioma belongs to the family of neuroendocrine tumor which is commonly located in the retroperitoneum in close proximity with other major vascular structures. In this article, we report our experience on the surgical removal of a highly vascular retroperitoneal paraganglioma that necessitated inferior vena cava reconstruction as well as a Whipple operation in a 15-year old boy. Both procedures are invasive and uncommonly performed in pediatric patients. Yet, these two procedures when combined together allowed complete en-bloc resection of the tumor. Lastly, the incorporation of pancreaticogastrostomy for reconstruction will also be discussed.

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Paraganglioma is an uncommon neuroendocrine tumor which arises from the extra-adrenal neural crest tissue [1]. Surgical resection offers the only realistic long-term cure [2]. In this article, we report our experience in the en-bloc resection of a highly vascular retroperitoneal paraganglioma with a Whipple operation (with reconstruction using pancreaticogastrostomy) followed by reconstruction of the inferior vena cava in a 15-year old boy.

1. Case summary

A 15 year-old boy presented with epigastric pain and a progressively enlarging abdominal mass over several months. Baseline blood tests including complete blood count, liver and renal functions as well as tumor markers were all unremarkable. The urinary vanillylmandelic acid (VMA) and homovanillic acid (HVA) levels were also within normal range (VMA: 1.7 umol/mmol Cr and HVA: 2.2 umol/mmol Cr). Contrast-enhanced computed tomography of the whole body revealed a 9 cm × 8 cm × 10 cm hypervascular tumor at the hypochondrial space displacing medially the gastro-hepatic ligament and the right kidney. Tumor encasement of the right renal hilum, inferior vena cava (IVC) and the infra-renal aorta (Fig. 1) was found. No distant metastasis was found. Exploratory laparotomy with an attempt for resection or at least an incisional

biopsy for histological confirmation was performed after embolization of the tumor feeding vessels. However, the tumor was found to be still highly vascular intra-operatively despite embolization and therefore, only an incisional biopsy for diagnosis was performed. Pathological examination of the biopsied specimen confirmed the diagnosis of paraganglioma.

Bevacizumab (trade name Avastin), an angiogenesis inhibitor, was given for a total of ten courses. The tumor responded during the initial phases but interval CT scan showed tumor progression in terms of size as well as vascularity. As such, exploratory laparotomy with a view for radical resection was contemplated.

On laparotomy, it was found that the tumor was firmly adhered to the common bile duct (CBD) and the duodenum. The main bulk of tumor occupied the right retroperitoneal region. In view of multi-visceral involvement, a Whipple operation with en-bloc tumor excision was performed. The tumor was mobilized medially together with the duodenum until the anterior surface of aorta was exposed. Cholecystectomy was performed and CBD was transected just above the cystic duct junction. The common hepatic artery was safeguarded and skeletonized until the junction with the splenic artery. The gastroduodenal artery was isolated and divided. Antrectomy was performed by a stapler. The duodenojejunal flexure was mobilized and the proximal jejunum was divided. The uncinate process of pancreas was dissected away from the superior mesenteric artery. The pancreas was transected at the neck region and the head of pancreas was mobilized from the main portal vein. Further dissection revealed dense tumor adhesion surrounding the infra-renal portion of IVC. The supra-renal IVC, distal part of

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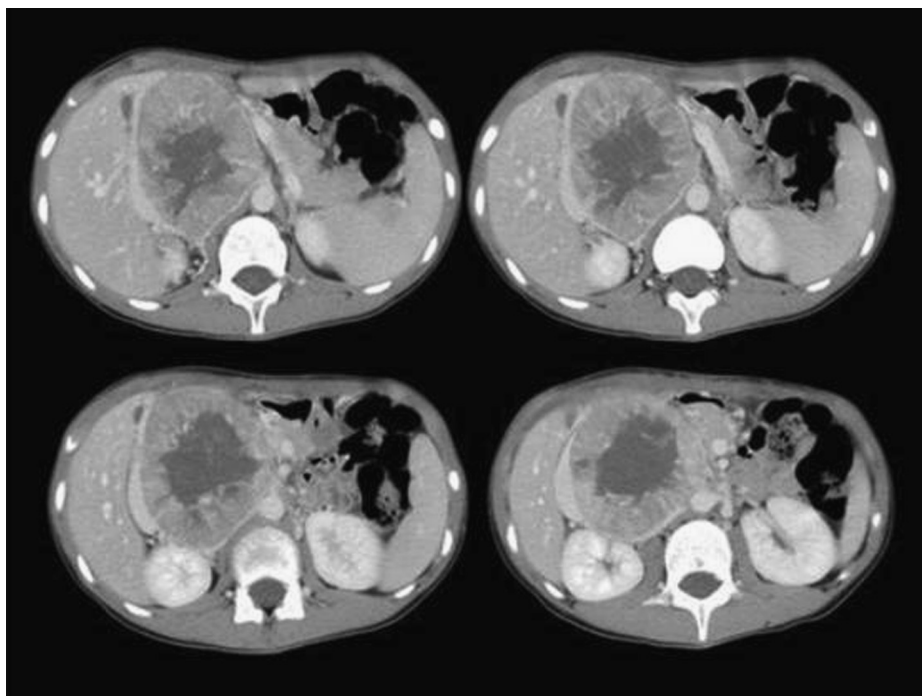


Fig. 1. Pre-operative CT scan showing a highly vascular paraganglioma abutting a long segment of the IVC.

right renal vein and caudal segment of IVC were then slung and cross-clamped. Upon cutting open the anterior wall of the isolated segment of IVC, tumor thrombus was found at the orifice of the right renal vein extending into the IVC. Hence, to achieve complete tumor resection inside as well as outside IVC, the involved segment of vena cava was excised en-bloc with the main tumor bulk and the specimen was removed.

The IVC was then reconstructed with a 20 mm Ringed Goretex graft (GORE-TEX®) with re-implantation of the right renal vein into the graft (Fig. 2). The procedure was followed by restoration of gastrointestinal continuity with a Roux-en-Y hepaticojejunostomy, pancreatogastrotomy (Fig. 3), gastrojejunostomy and jejunojunctionostomy. The pancreaticogastrotomy was constructed by pulling the pancreatic body in the stomach and a purse string in the posterior wall of the stomach was used to secure the pancreas into the stomach. The IVC graft was covered by greater omentum before wound closure.

His early post-operative recovery was complicated by an episode of hematemesis. No bleeding source was identified with upper endoscopy examination except some blood clots inside the stomach and duodenum. Re-laparotomy and gastrotomy also revealed no major source of bleeding in the stomach. On-table enteroscopy did not reveal any bleeding source in the proximal small bowel or in the jejunojunctionostomy. All the anastomoses were intact and no other bleeding source was identified. Postoperative recovery was uneventful. Anticoagulation was not given to prevent graft thrombosis in view of the high blood volume and the high velocity of venous return in the IVC. Pathological examination confirmed the diagnosis of paraganglioma which was positive for synaptophysin and S100 protein. The resection margin was clear of tumor.

2. Discussion

Paraganglioma belongs to the family of neuroendocrine tumor and arises from the extra-adrenal neural crest tissue, sharing similar

originality as pheochromocytoma which is commonly found inside adrenal medulla [1]. Clinical presentations are variable that may include functional symptoms such as hypertension and palpitation as a result of increased secretion of catecholamine. Abdominal pain and distension are other common symptoms. A minority of patients are diagnosed during family screening as hereditary tendency has



Fig. 2. Reconstruction of IVC using Goretex graft after en bloc resection of the tumor.

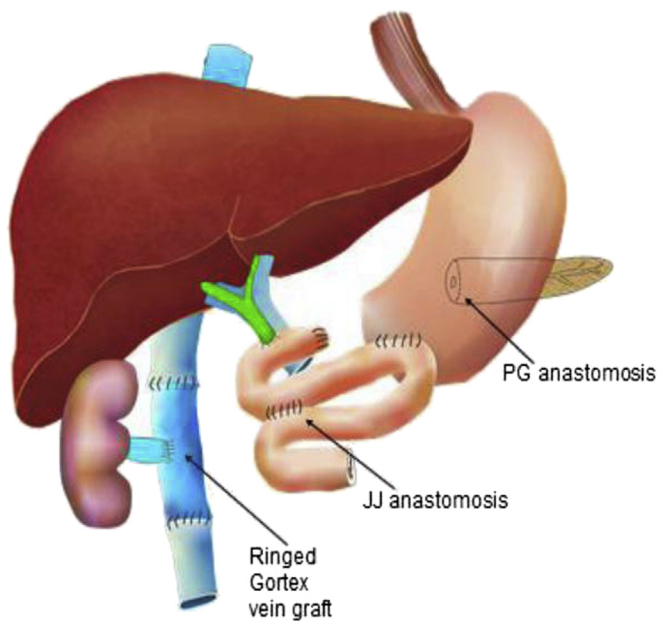


Fig. 3. Schematic diagram showing the reconstruction after tumor excision according to the principle of Whipple operation.

been reported [3]. In catecholamine-secreting type of tumor, diagnosis is usually confirmed with elevation of serum catecholamine or its derivatives in conjunction with imaging studies for tumor localization [4]. Occasionally, functional radioisotope scan such as ^{123}I -metaiodobenzylguanidine scan or ^{18}F -fluorodeoxyglucose (FDG) positron emission tomography (PET) may help to establish the diagnosis and staging of the disease [5].

Since there are no definitive criteria on histology to differentiate benign and malignant lesion, the tumor is usually regarded to be malignant if there is presence of metastasis, multi-focal involvement or recurrence after resection [6]. However, even an apparently benign lesion can invade into adjacent structure or major vessels, making surgical resection difficult. Although pre-operative imaging may reveal some of these features, it is not uncommon for these findings to become obvious only after exploration. Hence, the possibility of aborting the operation without resecting the tumor should always be discussed with parents when obtaining consent.

Surgical resection offers cure to patients with paraganglioma. One of the technical difficulties that we encountered in this operation was the vascular nature of the tumor and its close adherence

to the IVC, bile duct, and second part of duodenum. Furthermore, failed embolization of the tumor-feeding vessels by previous radiological attempts implied separating the tumor from IVC would be difficult and may result in exsanguination. In order to resolve this technical issue, en-bloc tumor excision with the involved segment of IVC was performed. The use of artificial Goretex graft for major vascular reconstruction in children is uncommon. Anecdotal report has described its application for hepatic artery anastomosis in liver transplantation [7]. The idea of resecting the tumor with IVC was not our first operative strategy because the possibility of graft complications exists. However, at the end, we believe it was still justified in this life-saving operation, especially when all adjuvant treatments that aim at reducing vascularity have failed. Traditional practice is to anti-coagulate patient with synthetic vascular graft but we believe this is not necessary for him since flow velocity inside IVC should be high enough to prevent thrombus formation.

Another point for discussion was the inclusion of a Whipple operation in a child. Due to the rarity of pancreatic neoplasms in children, this operation is seldom performed in pediatric patients. A study by Dasgupta and Kim [8] reported only 20 cases had been published and the operative outcomes in terms of operative time, complication and mortality rate were similar to that with the adults. Later, Muller [9] reported an average operating time of performing pancreaticoduodenectomy in children was similar to reports in adult literatures.

One of the major technical challenges in a Whipple operation is the reconstruction of pancreatic-enteric anastomosis. Pancreatic fistula remains an Achilles's heel for radical pancreaticoduodenectomy, with an incidence of 10–20% in different series [10,11]. Various methods of reconstruction have been proposed such as duct-to-mucosa pancreaticojejunostomy, dunking technique and pancreaticogastrostomy [12–14]. Nonetheless, previous meta-analysis and prospective randomized trials showed no difference in the pancreatic leakage rate among different anastomotic techniques [15,16] and this prompted the effort for further improvement to refine the technicality of pancreatic anastomosis in order to minimize the leakage rate. Peng proposed the use of a binding type of pancreaticojejunostomy and showed a 'zero' leakage rate in a prospective randomized trial [17]. However, such encouraging results could not be reproduced in further studies conducted by a French and an Italian group [18,19]. Recently, a binding-type of pancreatic-gastrostomy (PG) was advocated, especially for pancreas with soft consistency and small caliber pancreatic duct [20]. In a binding PG, the pancreas was mobilized away from the retroperitoneal bed and was brought into the gastric cavity via a posterior gastrotomy (Fig. 4a, b). A purse-string suture at the posterior gastric wall was then tightened up to secure the position

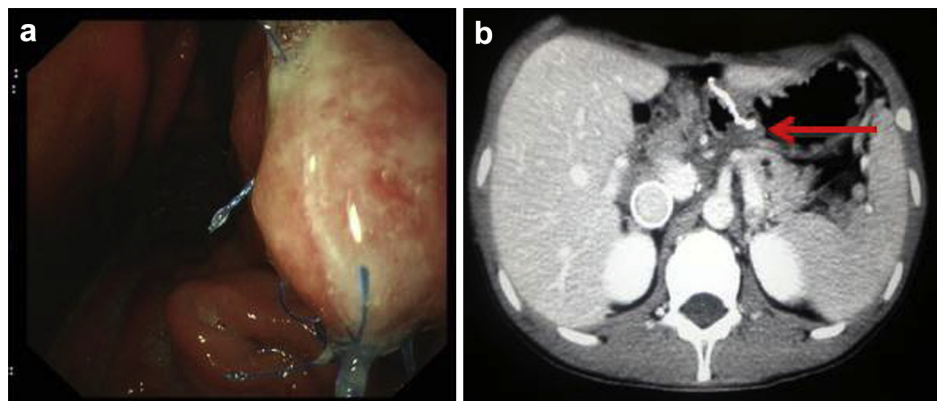


Fig. 4. (a) Endoscopic view of a binding pancreaticogastrostomy. (b) A cross-sectional view of binding pancreaticogastrostomy (arrow) on computed tomography.

of the pancreatic remnant. An anterior gastrotomy was made and the gastric mucosa was approximated to the pancreatic capsule by interrupted suture, one on each side of the pancreatic capsule. The anterior gastrotomy was finally incorporated into the gastrojejunostomy.

The advantage of this technique of pancreatic anastomosis is two folds: in a conventional type of pancreatic anastomosis, pancreatic enzymes could potentially leak from the insertion sites of sutures that pass through the pancreatic capsule. In a binding PG, this is no longer an issue as it is a suture-less type of anastomosis. More importantly, the main ductal orifice is completely incorporated into the gastric cavity and the gripping effect offered by the purse-string suture at the posterior gastric wall on the pancreatic remnant provided a fluid-tight barrier to prevent leakage of pancreatic enzymes into the pancreatic bed. Furthermore, the close proximity of the stomach to the pancreatic remnant significantly attenuates the tension across the pancreatic-enteric anastomosis facilitating healing, and the acidic gastric environment leads to inactivation of the pancreatic enzymes, hence minimizing the collateral damage caused by the digestive enzymes.

3. Conclusion

In summary, multi-visceral resection of retroperitoneal tumor involving the pancreaticoduodenal region is safe and feasible in children. A thorough understanding of the anatomical relationship between the tumor and other retroperitoneal organs facilitate an aggressive surgical approach for this condition.

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