Preservation of Right Gastroepiploic Vein to Lessen Left-Sided Portal Hypertension after Conversion Pancreaticoduodenectomy with Concomitant Vascular Resection after Chemotherapy for a Locally Advanced Pancreatic Cancer

Hiroto Ishikawa*, Jyun Okadome1, Midori Yamamura1, Ayako Nakame1, Yoshiyuki Shirozuz1, Daisuke Muroya1, Satoshi Kuratsu1, Kazutaka Kadoya1, Yukiya Kishimoto1, Masayuki Okabe1, Tomokazu Kosuga1, Teiji Okazaki1, Keichiro Tayama1, Kenichi Kosuga1, Hirohisa Yano2, Koji Okuda2, Hiroyuki Tanaka2 and Yoshito Akagi2

1Department of Surgery, Munakata Suikokai General Hospital, Japan
2Department of Pathology, Kurume University School of Medicine, Japan
3Department of Surgery, Kurume University School of Medicine, Japan

Abstract

More than 30% to 40% of all cases of pancreatic cancer are initially considered unresectable. Unresectable Locally Advanced Pancreatic Cancer (UR-LAPC) patients have a poor prognosis worldwide, and almost all these patients have extensive vascular involvement and perineural invasion at initial diagnosis that precludes surgical intervention. Recently, some reports have revealed that induction chemotherapy followed by conversion surgery for UR-LAPC may be more efficacious.

In locally advanced pancreatic head and body cancer, Portal Vein (PV) and Superior Mesenteric Vein (SMV) is frequently involved because of the vein’s anatomical location. In Pancreaticoduodenectomy (PD) combined with vascular resection may cause secondary Left sided Portal Hypertension (LPH).

We report a case of successful conversion surgery for an initial UR-LAPC after induction GEM + nab-PTX chemotherapy. In PD with resection of PV, SMV, Splenic Vein (SV), inferior mesenteric vein (IMV) and Left Gastric Vein (LGV) confluence may cause secondary LPH, but concomitant preservation of Right Gastroepiploic Vein (RGEPV) may attenuate secondary LPH.

Keywords: Unresectable locally advanced pancreatic cancer; Left sided portal hypertension; Right gastroepiploic vein

Introduction

The number of deaths due to pancreatic cancer have risen quickly in Japan (>30,000 cases/year), and almost all UR-LAPC patients have extensive vascular involvement and perineural invasion at initial diagnosis that precludes surgical intervention [1]. UR-LAPC is defined as unresectable pancreatic cancer due to vascular involvement without radio graphically distant metastases [2]. Although PV/SMV invasion was previously considered to be a contraindication for resection, some patients with PV/SMV invasion who undergo combined resection of these vessels achieve long term survival equivalent to that in those without vascular invasion [3]. Recently, some reports have revealed that induction chemotherapy followed by conversion surgery for UR-LAPC may be more effective [4].

In Pancreaticoduodenectomy (PD) combined with vascular resection may cause secondary left sided portal hypertension (LPH) [5]. Especially, in PD with resection of PV-SMV confluence, we had resected SV, IMV and LGV without reconstruction. After division of SV, IMV and LGV congested venous flow of SV produces various routes and results in splenomegaly, which are defined as secondary LPH, causing variceal bleeding and thrombocytopenia by hypersplenism. Variceal bleeding after LPH is repeatable or massive in some patients, resulting in fatal hypovolemic shock. Over the past 10 years, a few cases were reported about the failure of radical operation for patients...
with UR-LAPC and secondary LPH, and these surgeons considered the secondary LPH as a potential risk for failure of radical operation [6-7].

**Case Presentation**

A 55-year-old female was referred to our facilities with the complaint of epigastralgia and back pain. Physiological and laboratory assessments were unremarkable except for elevated serum CA19-9 (CA19-9, 226.5 U/ml). Enhanced Multi-Detector CT (MDCT) revealed a hypovascular tumor measuring 27 mm in the uncinate process of the pancreas. The tumor was in contact with more than 180 degrees of the Common Hepatic Artery (CHA) and Gastroduodenal Artery (GDA) perimeter, with invasion extending from the Superior Mesenteric Vein (SMV) to the Portal Vein (PV) (Figure 1). Endoscopic Retrograde Cholangio-Pancreatography (ERCP) demonstrated stenosis of the main pancreatic duct and distal duct dilatation. Pancreatic juice cytology was categorized as class V (Adenocarcinoma). Both Positron Emission Tomography (PET) and Ethoxybenzyl-Magnetic Resonance Imaging (EOB-MRI) showed no evidence of distant metastasis.

The patient was diagnosed with pancreatic head cancer cStage IIA (Ph, TS2 (27 mm), cT3 cCH0, cDU0, cS1, cRP1, cPL1, cVsm1, cAch1, cN0, cM0) that was also categorized as an unresectable locally advanced pancreatic cancer (UR-LAPC) according to the Japan Pancreatic Society classification, 7th edition, and subsequently received induction chemotherapy (Gemcitabine (GEM) 1000 mg/m² + nanoparticle albumin-bound paclitaxel (nab-PTX) 125 mg/m²) on days 1, 8 and 15 of a 28-day cycle, aimed at conversion surgery. Enhanced MDCT imaging demonstrated an effective response to GEM+nabPTX therapy. Significant shrinkage of the primary tumor occurred after 8 cycles of GEM+nabPTX therapy (Figure 2). The tumor size decreased from 27 mm to 10 mm and contact with the CHA decreased. The level of CA19-9 decreased from 226.5 U/ml to normal range (Figure 3).

She underwent a radical Subtotal Stomach-Preserved PD (SSPPD) concomitant resection of the PV, SMV, SV, IMV and LGV confluence. The anastomosis between PV and SMV was performed by 6-0 non-absorbable running suture. The SV, IMV and LGV were divided and not reconstructed. Furthermore, the Right Gastroepiploic Vein (RGEV) was preserved to prevent secondary Left Sided Portal Hypertension (LPH). The procedure lasted 10hr and 56min with a blood loss of 80 g. The patient was discharged home after 24th postoperative day without complications. To assess the development of secondary LPH, the existence of intraabdominal varices and the change of spleen volume was evaluated at the time before operation, 6 months and 12 months postoperatively using digestive endoscopy and enhanced MDCT. Venous flow of SV passed through the Left Gastroepiploic Vein (LGEPV) and RGEV draining to PV. The formation of postoperative esophageal and gastric varices was not confirmed. There was no change in spleen volume before, 6 months and 12 months after RGEVP preserved SSPPD (Figure 4).

Histopathological examination of the resected tissue revealed an invasive ductal carcinoma, a tubular Adenocarcinoma well differentiated type (tu1h1), Ph, TS1 (12 mm × 10 mm), infiltrative type, ypT1, ypCH0, ypDU0, ypS0, ypRP0, ypPV0, ypA0, ypPL0, ypOO0, ypPCM0, ypBCM0, ypDCM0, intermediate type, INFβ, ly0, v0, n1, mpd0, ypN0(0/49), ypM0, ypT1N0M0 ypStage I. Microscopic pathological examination showed R0 (no residual tumor) resection, and 10% to 50% of the tumor cells were replaced with fibrosis (Evans grade IIa). She was administered an almost full dose of S-1 as adjuvant chemotherapy for 6 months after operation and has shown no signs of secondary LPH and recurrence in 13 months. Rapid induction GEM+nab-PTX chemotherapy for UR-LAPC might be a safe and effective treatment option. Furthermore, preservation of RGEVP may attenuate the secondary LPH after PD with combined resection of SMV, PV, SV, IMV and LGV confluence.

**Discussion**

Pancreatic cancer is one of the most lethal malignancies. The
The duration of GEM+nab-PTX therapy in our case was 8 months. According to previous reports, the median duration of induction chemotherapy in patients who underwent conversion surgery is 7 months to 9 months [13]. Satoi et al. [14] reported that OS of patients treated with conversion surgery for resectable or borderline resectable pancreatic cancer was significantly improved compared to that with GEM+nab-PTX therapy or resection alone (21.5 months vs. 12.5 months, respectively; P<0.0002) [11]. Ueno et al. reported that GEM+nab-PTX therapy shows better efficacy compared to GEM or GEM+S-1 therapy for patients with UR-LAPC (response rate: 69.2% vs. 40.9% respectively; P<0.002) [11]. Sato et al. [8] reported that OS of patients treated with conversion surgery with GEM+nab-PTX therapy for resectable or borderline resectable pancreatic cancer was significantly improved compared to that with chemotherapy alone (21 vs. 12.5 months, respectively; P<0.0002) [11]. Ueno et al. reported that GEM+nab-PTX therapy shows better efficacy compared to GEM or GEM+S-1 therapy for patients with UR-LAPC (response rate: 69.2% vs. 30%, respectively) [12]. In our case, histopathological finding revealed high efficacy of GEM+nab-PTX therapy, and the patient is currently in long-term, relapse-free survival. GEM+nab-PTX therapy may be one of the most useful options for the treatment of UR-LAPC and is expected to improve prognosis when followed by conversion surgery.

The evaluation of chemotherapy efficacy [16]. In our case, the level of CA19-9 decreased from 226.5 U/ml to normal range.

In pancreatic head and body cancer, PV and SMV are frequently involved because of the vein’s anatomical location. Pancreatic cancer can lead to Left Sided Portal Hypertension (LPH) by direct invasion and extrinsic compression via mass effect or hypercoagulable state. LPH was first reported by Greenwald and Wasch in 1939, and it was distinguished from other forms of portal hypertension by preserved liver function and a patent extra hepatic portal vein [14]. In Pancreaticoduodenectomy (PD) combined with vascular resection may cause secondary LPH. LPH is a clinical syndrome due to outflow block of SV, developing varices with hemorrhage and splenomegaly with thrombo-cytopenia. Variceal bleeding after LPH is repeatable or massive in some patients, resulting in fatal hypovolemic shock [6].

In our case, following 8 courses of GEM+nab-PTX therapy, the extent of tumor invasion to the CHA and SMV was improved and the evaluation of chemotherapy efficacy [16]. In our case, the level of CA19-9 decreased from 226.5 U/ml to normal range.

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In our case, following 8 courses of GEM+nab-PTX therapy, the extent of tumor invasion to the CHA and SMV was improved and the level of CA19-9 decreased significantly. A radical Subtotal Stomach-Preserved PD (SSPPD) concomitant resection of the SMV, PV, SV, IMV and LGV confluence was performed. Because it contributes to R0 achievement and it believed to survival benefit without increasing postoperative morbidity and mortality. The anastomosis between PV and SMV was performed by 6-0 non-absorbable running suture. SV, IMV and LGV were divided and not reconstructed. Furthermore, the Right Gastroepiploic Vein (RGEPV) was preserved to prevent secondary LPH. To assess the development of secondary LPH, the existence of intraabdominal varices, the change of spleen volume was evaluated at the time before, 6 months and 12 months postoperatively using digestive endoscopy, enhanced MDCT and the change of platelet counts. The formation of postoperative esophageal and gastric varices was not confirmed. 3D-CT scan showed the development of collateral blood flow as follows: SV→LGEPV→RGEPV→SMV→PV. There was no change in spleen volume before and after operation (before operation, 132.1 ml; 6 months, 126.3 ml; 12 months; 135.1 ml), but platelet counts decreased after operation (before operation,
25.3 × 10^3/ul; 6 months, 21 × 10^3/ul; 12 months, 14 × 10^3/ul) due to adjuvant chemotherapy (S-1). Preservation of RGEPV may attenuate the secondary LPH in PD with resection of PV-SMV-SV-IMV-LGV confluence.

**Conclusion**

We report a case of successful conversion surgery for an initial UR-LAPC after induction GEM+nab-PTX chemotherapy. PD with resection of PV, SMV, SV, IMV and LGV confluence may cause secondary LPH, but concomitant preservation of RGEPV may attenuate secondary LPH.

**References**