

## Bile duct cancers: What can EUS offer? Intraductal US, 3D-IDUS? FNA – is it possible?

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### Introduction

An international workshop on the clinical impact of endoscopic ultrasound in gastroenterology in conjunction with the 12<sup>th</sup> international symposium on endoscopic ultrasonography, held in Monaco in 2000. In the workshop, new indications for EUS in the biliary tract were discussed [1]. The major application of EUS in biliary tract cancers concerns tumor staging. Accurate diagnosis of cancer extension is necessary for adequate surgical procedures. Intraductal ultrasonography (IDUS) is a reliable method that can be used for more detailed evaluation of bile duct cancer. We reported the usefulness of three-dimensional intraductal ultrasonography (3D-IDUS) for comprehensive evaluation of extension of biliary tract tumors [2]. Although EUS-guided fine needle aspiration (FNA) is performed usually in pancreatic tumors, it is not standardized in biliary tract tumors. In this report, we reviewed the usefulness of EUS, IDUS, 3D-IDUS and EUS-FNA for diagnosis and treatment of bile duct cancers.

### What can EUS offer for diagnosis of bile duct cancers?

Because EUS reveals the extrahepatic bile ducts in almost all patients, it is the most reliable method for diagnosis of obstructive

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jaundice. However, the depth of field is limited so that the exploration of the hilum is generally not possible. When we suspect a biliary disease, we always use conventional ultrasonography (US) as the first diagnostic imaging. When US revealed an extrahepatic obstructive jaundice, what kind of examination is performed? EUS had proved as a gold standard in the exploration of extrahepatic obstruction due to its low morbidity and its accuracy [3,4]. However, other radiological examinations are recently developed for the diagnosis of the biliary tract, multi-detector-row CT (MD-CT) and magnetic resonance cholangiopancreatography (MRCP). These procedures appear to have advantages because they are non-invasive and able to simultaneously depict the whole biliary tract, the pancreatic duct and the liver and pancreas. However, CT and MRCP are limited for the exploration of small lesions [5,6]. Therefore, EUS is still the best procedure for the diagnosis of biliary obstruction, as well as the most accurate when diagnosing extrahepatic obstruction and staging tumors. EUS can offer a precise diagnosis and staging of biliary tract tumors [7,8]. Although EUS offer a precise diagnosis in the middle and distal segments of the biliary tract, MRCP and direct cholangiography (ERC or PTC) are better than EUS in the proximal region.

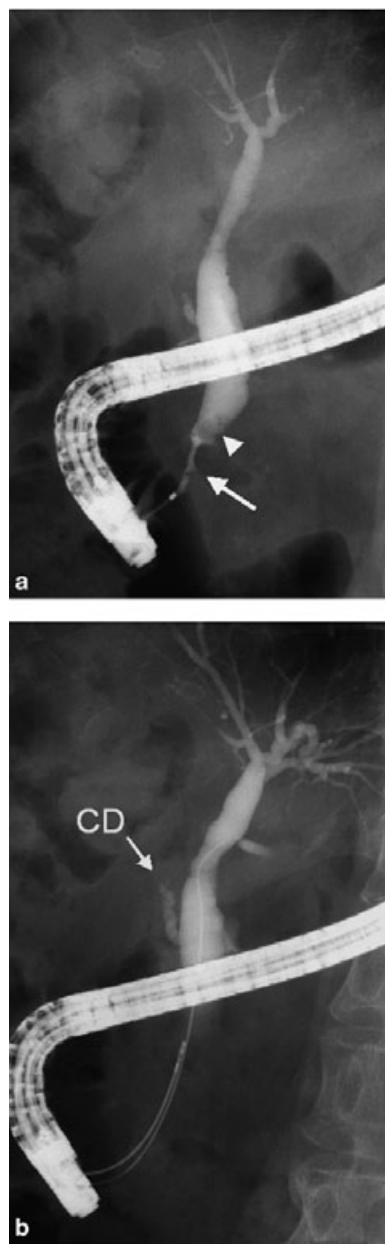
### What can IDUS and 3D-IDUS offer?

IDUS using a high-frequency ultrasonic miniature probe is accurate for diagnosing biliary strictures [9] and staging of bile duct cancers. IDUS was reported the limitation for tight stenosis [10]. However, miniature ultrasonic probe have been developing. The ultrasonic probe with ropeway system increased success rate in transpapillary approach [11]. Using the ropeway system with a guide-wire, scanning of the bile duct was achieved in 98.2 to 99.2% of the patients, regardless of the site and length of the biliary strictures. Once the guide-wire passed through the biliary stenosis, no further technique like endoscopic sphincterotomy or dilatation of stenosis is required to introduce the ultrasonic probe (Fig. 1A, 1B).

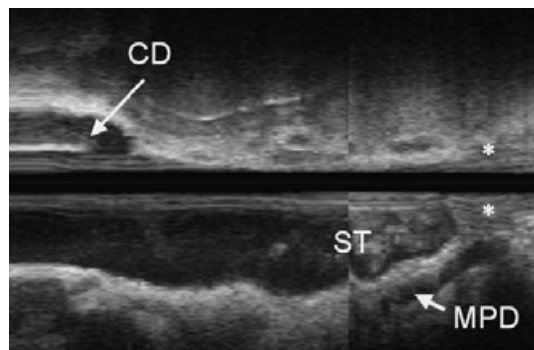
Menzel et al. [12] reported the usefulness of IDUS for diagnosis of bile duct cancers, tumor extent was diagnosed correctly in 76.8% of cases when using IDUS and in 53.6% cases in EUS. For hilar-hepatic tumors, EUS has limitations for diagnosis and staging, but IDUS is accurate for staging [13]. IDUS is useful to demonstrate clearly invasion of the pancreas or portal vein [14,15]. However, it is difficult to diagnose histological infiltration of the fibrous layer of the peri-muscular loose connective tissue in T1 tumors [16].

We performed IDUS since 1989 and 3D-IDUS since 1995 [15,17]. Since 1997, we usually used a ropeway system probe UM5RG-29R, 2.9 mm in diameter, developed by Olympus Medical Systems (Tokyo, Japan), incorporated a radial scanning system with a frequency of 20 MHz. The probe was connected to an endoscopic ultrasonic observation unit (EU-M30, or EU-M2000; Olympus Medical Systems). The probe was easily passed through the 2.8 mm diameter biopsy channel of the duodenoelectronic scope (JF-200, JF230, or TJF 200; Olympus Medical Systems). We used a 3D-IDUS system, developed by Olympus Medical Systems; an ultrasound image processing unit, EU-IP2; a 3D ultrasonic probe, UM-3D-3R (20 MHz), with a diameter of 3.4 mm; and a probe driving

unit, MAJ-355, since 1995. These were connected to an endoscopic ultrasonic observation unit (EU-M30 or EU-M2000).



**Fig. 1** **a** Endoscopic retrograde cholangiopancreatography reveals an irregular stenosis (arrow) of the distal common bile duct and a filling defect (arrow head). **b** An ultrasonic probe is inserted into the bile duct along with a guide-wire through a biopsy-channel of a duodenoscope. CD, cystic duct.



**Fig. 2** 3D-IDUS of bile duct carcinoma; a composite sonogram of two sessions reveals a hypo-echoic mass (\*) and stone (ST) in the distal end of the common bile duct. CD, cystic duct, MPD, main pancreatic duct.

We could observe the bile duct wall as two to three layers. On the other hand, IDUS revealed a lesion of carcinoma as an image of low echoic, irregular thickness. When the tumor echogram reached the high echoic layer of the bile duct, we could diagnose that the tumor had invaded the subserosa. When the tumor echogram reached the parenchyma of the pancreas, it could be diagnosed that the pancreas had been invaded. The important findings to diagnose tumor invasion to the pancreas is a high echoic layer between the bile duct and the pancreas. When the tumor echogram reached the high echoic wall of the portal vein, it could be diagnosed that the portal vein had been invaded. The results of IDUS and pathological studies for tumor extension in 15 patients bile duct carcinoma were investigated. Over all accuracy for depth of tumor invasion was 93.3%, for tumor invasion of the pancreas was 86.7%, and invasion of the portal vein was 93.3%. The accuracy of IDUS in assessing tumor invasion to the pancreas was reported 88.9 to 100% [2,13,18,19]. The accuracy of IDUS in assessing tumor invasion to the right hepatic artery and portal vein was 92.3 to 100% [2,13,18,19].

We could produce longitudinal reconstruction images (Fig. 2) with using the functions of the 3D-IDUS systems, dual plane reconstruction (DPR) images (Fig. 3), including radial and longitudinal reconstruction images and oblique reconstruction images (Fig. 4). DPR and oblique reconstruction images are useful to assess the tumor extension and the relationship with surrounding organs. 3D-IDUS is useful for the precise diagnosis of cancer extension in bile duct cancers, especially in invasion into the portal vein and pancreas. The other advantage of 3D-IDUS is that the time required for the examinations is reduced compared with that required for conventional IDUS, because conventional IDUS needs to clarify the relationship between lesions and surrounding organs and vessels.

Intraductal spreading of tumor is known as one of the characteristics of tumor extension of extrahepatic bile duct carcinoma. When the irregular thickness of the bile duct is observed consecutively and away from the main lesion, it could be diagnosed that intraductal spreading of cancer existed. The results of 3D-IDUS and pathological diagnosis for intraductal tumor spreading were studied in 11 patients on whom surgery was performed. Over all accuracy of 3D-IDUS for intraductal tumor spreading was only 70.0%. The result was not satisfied as Tamada et al. [16] reported limitation of 3D-IDUS in the assessment of longitudinal spread. Other problem of IDUS and 3D-IDUS for diagnosis of bile duct cancer is limitations in diagnosis of lymph node metastasis [20]. Menzel et al. [21] reported that when each depictable lymph node was considered to be suggestive of malignancy, with regard to N-staging, EUS was significantly superior to IDUS (64.9% vs. 33.3%).

### FNA – is it possible?

EUS guided cholangiography was reported at first by Wiersema et al. [22] in 1996. The procedure was used for selective opacification of biliary ducts under direct EUS guidance. They obtained a successful cholangiopancreatography in 8 out of 11 patients. The procedure is useful for patients in which ERCP had been unsuccessful.

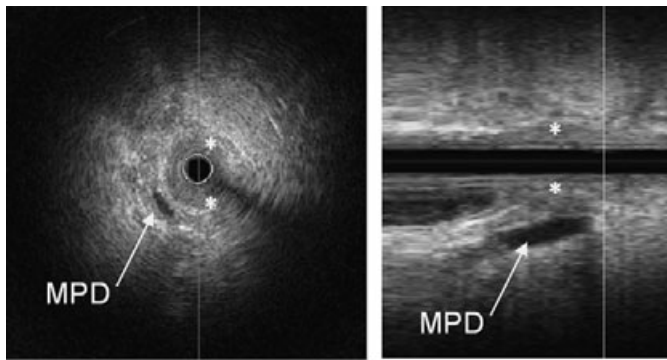


Fig. 3 DPR images, including radial and longitudinal reconstruction images, reveal easily the relationship between the tumor (\*) and the main pancreatic duct (MPD).

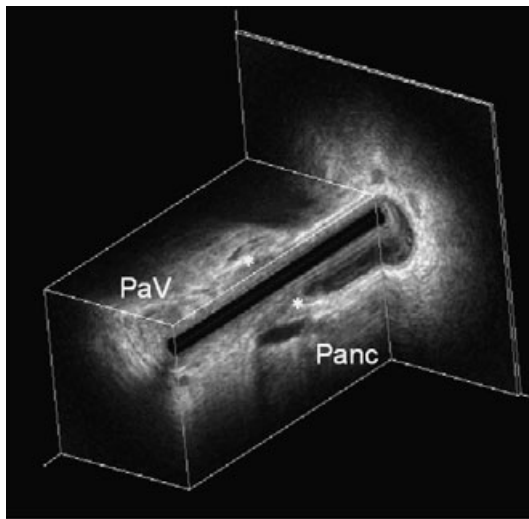


Fig. 4 Oblique reconstruction images reveal comprehensively the relationship between the tumor (\*) and the pancreas (Panc). PaV, papilla of Vater.

EUS-guided fine-needle aspiration cytology is reported as a safe and accurate method for diagnosis of hilar cholangiocarcinoma [23,24]. This technique may represent a new approach to diagnosis when other method, like brush cytology, fail [24,25]. The practice of EUS-FNA has improved the diagnostic yield of EUS [26]. EUS-FNA is a new, exciting technique, and may become a essential procedure for conclusive diagnosis of bile duct carcinoma suspected with other imaging modality.

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