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Intraprocedural hologram support with mixed-reality technique in endoscopic ultrasound-guided biliary drainage

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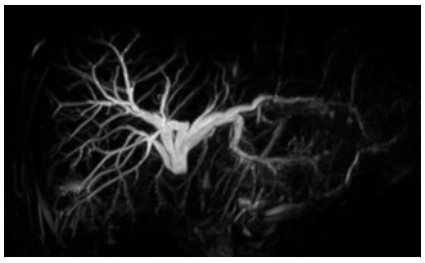
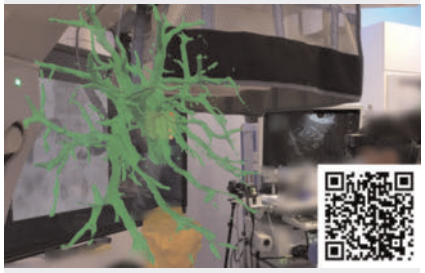
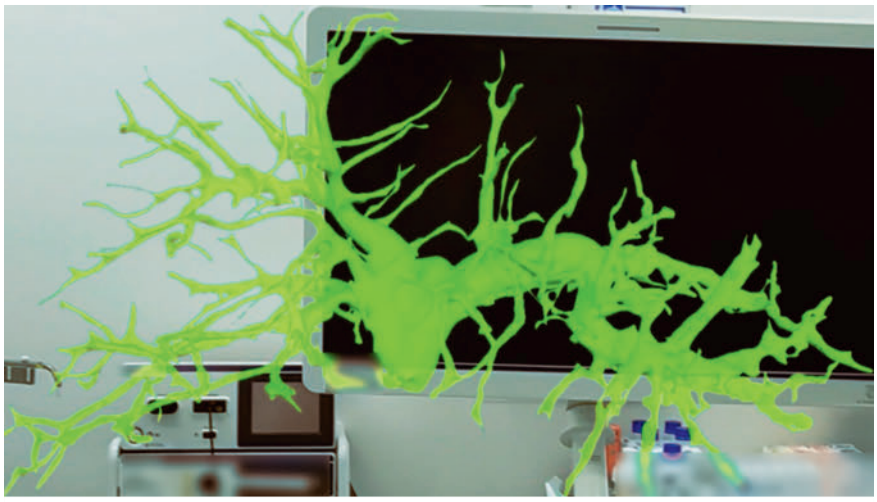


▶ **Fig. 1** Magnetic resonance cholangiopancreatography (MRCP) image of the biliary tract.

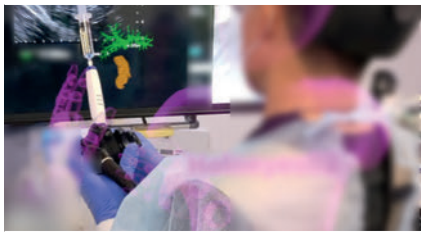


Video 1 Endoscopic ultrasound-guided biliary drainage using a 3D cholangiographic image projected in space as a reference.



▶ **Fig. 2** 3D cholangiographic image created from MRCP projected on a HoloLens head-mounted display.

▶ **Fig. 3** The HoloLens head-mounted display.



▶ **Fig. 4** The image shows the operator wearing a head-mounted display, identifying the appropriate puncture point using the 3D cholangiogram projected in space.

Endoscopic ultrasound-guided biliary drainage (EUS-BD) is being used increasingly frequently in patients with benign biliary diseases [1, 2]. However, puncturing and exploring the intrahepatic bile duct, which runs in a complicated tortuous fashion, can be challenging using two-dimensional (2D) images of EUS and fluoroscopy. Successful EUS-BD is necessary to understand the biliary anatomy, identify the appropriate puncture point, and advance the guidewire smoothly. Thus, it would be ideal to have a device that could confirm the bile duct route with a three-dimensional (3D) device during the procedure. Holograms, which are computer-generated graphics models, have recently been used with mixed reality techniques as a surgical navigation tool [3, 4]. Herein we report the first case of EUS-BD using a 3D hologram of the bile duct.

A 26-year-old woman with a history of pancreatoduodenectomy for a solid pseudopapillary neoplasm of the pancreas presented with cholangitis due to a biliojejunal anastomotic stricture. We decided to perform an EUS-guided hepaticogastrostomy. 3D images of the biliary tract were created from magnetic resonance cholangiopancreatography (▶ **Fig. 1**) using SYNAPSE VINCENT (Fuji Film Medical Co., Ltd., Tokyo, Japan). Data were converted into 3D polygon data (▶ **Fig. 2**) using the Holoeyes XR system (Holoeyes Inc., Tokyo, Japan) installed on a HoloLens head-mounted display (Microsoft Co., Redmond, Washington, USA) (▶ **Fig. 3**). Although the bile duct was thin and complicated, the operator wearing the head-mounted display was able to identify the appropriate puncture point from the 3D cholangiogram projected in space (▶ **Fig. 4**) and successfully complete the procedure (▶ **Video 1**).

To our knowledge, this is the first report of EUS-BD using a 3D hologram. A 3D cholangiogram may make it easier for some to understand the biliary anatomy than a 2D image. This is an innovative technology that allows EUS-BD to be safely performed.

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Conflict of Interest

T. Itoi and T. Tsuchiya are consultants for Gadelius Medical Corporation. M. Sugimoto is an employee of Holoeyes, Inc. The other authors declare no financial relationships relevant to this study.

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