ORIGINAL ARTICLE

Artificial intelligence system for EUS navigation and anatomical landmark recognition

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Background and Aims: The use of artificial intelligence (AI) has been introduced in several medical fields with promising results, including endoscopy. In the field of EUS, studies using AI are still limited and have mostly focused on the identification and characterization of pancreatic masses. Recently, AI systems based on deep learning have been developed to identify anatomical landmarks during diagnostic EUS.

Methods: The Endoangel system (Wuhan ENDOANGEL Medical Technology, Wuhan, China), built using deep convolutional neural networks (DCNNs), is able to provide navigation hints and identify anatomical landmarks in real time during diagnostic EUS. The system was trained with more than 550 EUS procedures and uses a DCNN that processes images through multiple layers by extracting features, introducing nonlinearity, reducing complexity, and making predictions via fully connected layers.

Results: The AI EUS system was tested in 3 patients undergoing diagnostic EUS. In each case, the correct recognition of anatomical landmarks by the AI EUS system was judged by a single expert performing the EUS examination. The system did not recognize pathologic alterations such as pancreatic masses or cystic lesions.

Conclusions: The AI EUS DCNN-based system is able to correctly identify EUS anatomical landmarks. In the near future, this system might play an important role in EUS training and quality control. In addition, many other features might progressively be added, with the next ideal step being the identification of pathologic alterations. (VideoGIE 2025;10:358-63.)

The use of artificial intelligence (AI) has been introduced in several medical fields with promising results including endoscopy. In the field of EUS, studies using AI are still limited and have mostly focused on the identification and characterization of pancreatic masses.[1-3] More recently, AI systems developed on the basis of deep learning have been developed to identify anatomical landmarks during EUS[4] (Fig. 1).

Abbreviations: AI, artificial intelligence; DCNN, deep convolutional neural network.

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DESCRIPTION OF TECHNOLOGY

The Endoangel (Wuhan ENDOANGEL Medical Technology, Wuhan, China) system (Fig. 1), built using deep convolutional neural networks (DCNNs), is able to provide navigation hints and to identify anatomical landmarks in real time during diagnostic EUS, in particular: (1) the pancreatic body alongside the splenic vein and artery; (2) the pancreatic tail in relation to the left kidney and the spleen; (3) the pancreatic head with the portal vein and biliary tract from the duodenal bulb; (4) the spleno-porto-mesenteric confluence; and (5) the abdominal aorta at the origin of the celiac trunk. Zhang et al[4] demonstrated that a deep learning-based system could accurately identify EUS stations and anatomical structures in real time. The model achieved 90% accuracy in station classification, which is comparable with that of experts. To date, the AI EUS system is not able to recognize pathology of any kind (solid nor cystic lesions), only normal anatomy and structures.[4,5]

The system was trained with more than 550 EUS procedures. The present AI EUS system uses DCNNs that process images through multiple layers by extracting features using convolution, introducing nonlinearity with activation

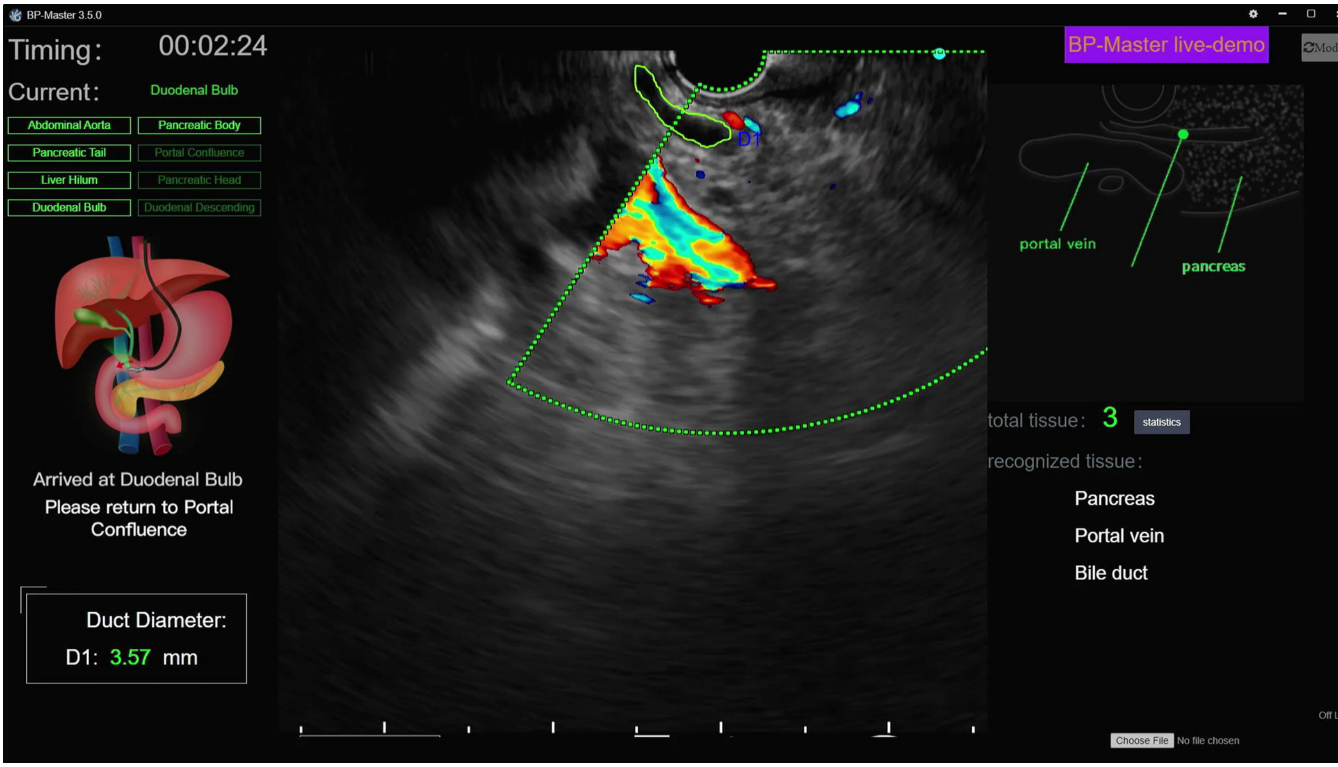

Figure 1. Identification and outline of the pancreatic head and of the common bile duct with its automatic measurement by the artificial intelligence system.

functions, reducing complexity through pooling, and making predictions via fully connected layers.[4,5] The AI EUS system is a class I medical device, and the specific declaration of conformity is available for the intended use in Europe, whereas approval from the Food and Drug Administration is still ongoing.

We report the use of this AI EUS DCNN system in 3 patients undergoing diagnostic EUS (Video 1, available online at www.videogie.org). Correct landmark recognition by the AI EUS system was judged in every case by a single expert performing the EUS examination.

CASE PRESENTATION

In the first case, a 65-year-old man came to our attention as the result of a family history of pancreatic cancer. Diagnostic EUS using GF-UCT180 linear echoendoscope coupled with am EU-ME2 ultrasound processor (Olympus, Tokyo, Japan) together with the AI EUS system was performed.

In this patient, the AI EUS system correctly recognized the abdominal aorta with celiac trunk and superior mesenteric artery take-off, the splenoportal confluence with the pancreatic neck, the pancreactic body together with splenic vein and artery (Fig. 2), and the pancreatic tail in relation with the left kidney (Fig. 3) and with the spleen (Fig. 4). Finally, from the duodenal bulb, the pancreatic head together with the portal vein were correctly identified. Use of color Doppler allowed for the identification and automatic measurement of the biliary tract (Fig. 1).

In the second case, a 58-year-old woman was referred for postprandial abdominal pain with abnormal liver function test results. An abdominal ultrasound demonstrated gallstones and common bile duct dilation. Diagnostic EUS using GF-UCT180 linear echoendoscope coupled with EU-ME2 ultrasound processor (Olympus) together with the AI EUS system was performed. From the gastric station, correct landmark recognition was observed for the celiac trunk (Fig. 5), pancreatic neck with splenoportal confluence (Fig. 6), pancreatic body with splenic vein and artery, and pancreatic tail in relation with the left kidney and the spleen. From the duodenal bulb, the pancreatic head with the portal vein was correctly identified. Color Doppler activation allowed for common bile duct identification and automatic caliber measurement. Choledocholithiasis was confirmed by the operator while, as mentioned previously, the present AI EUS system is not currently able to identify lesions of any kind.

In the last case, a 76-year-old man was referred for sudden onset of jaundice and evidence of a 18-mm hypovascular lesion of the pancreatic head on computed tomography scan. Diagnostic EUS using GF-UCT180 linear echoendoscope coupled with EU-ME2 ultrasound processor (Olympus) together with the AI EUS system was performed. From the

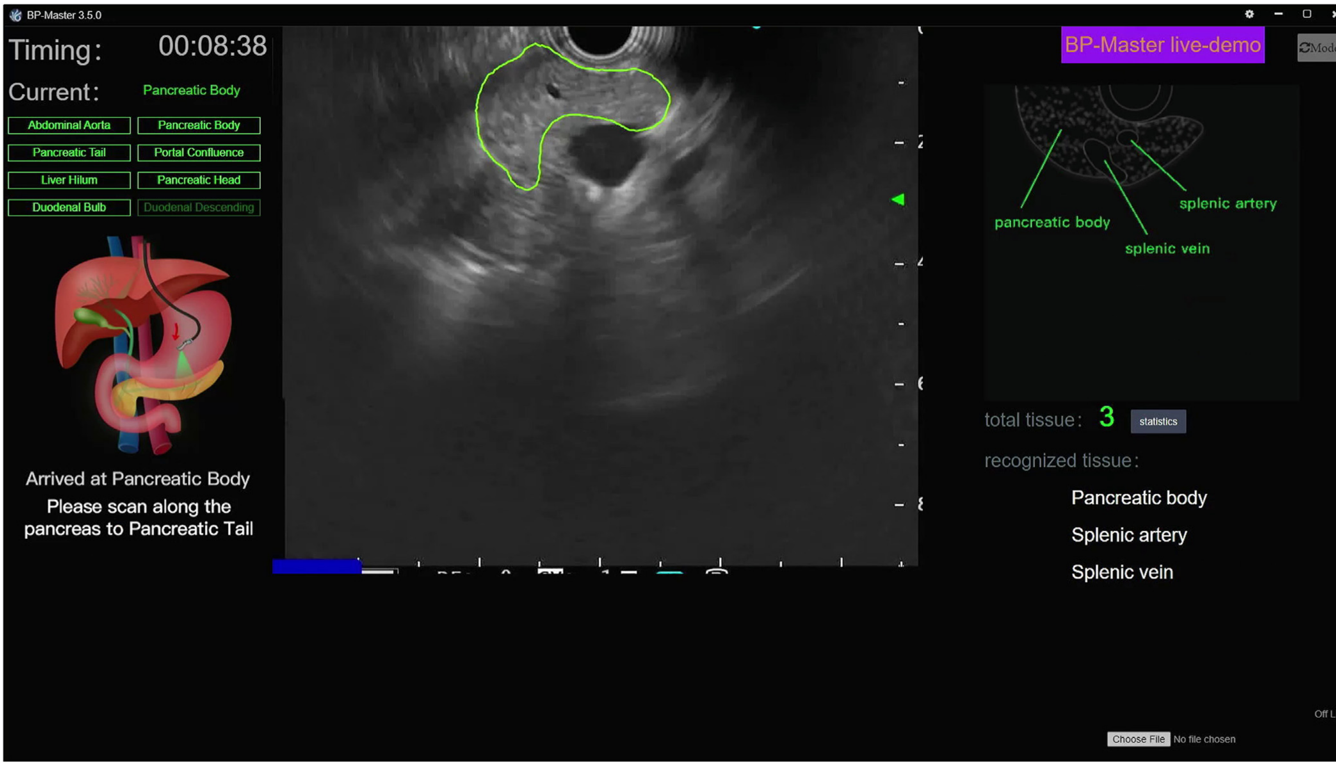

Figure 2. Identification and outline of the pancreatic body along the splenic vein and artery by the artificial intelligence system.

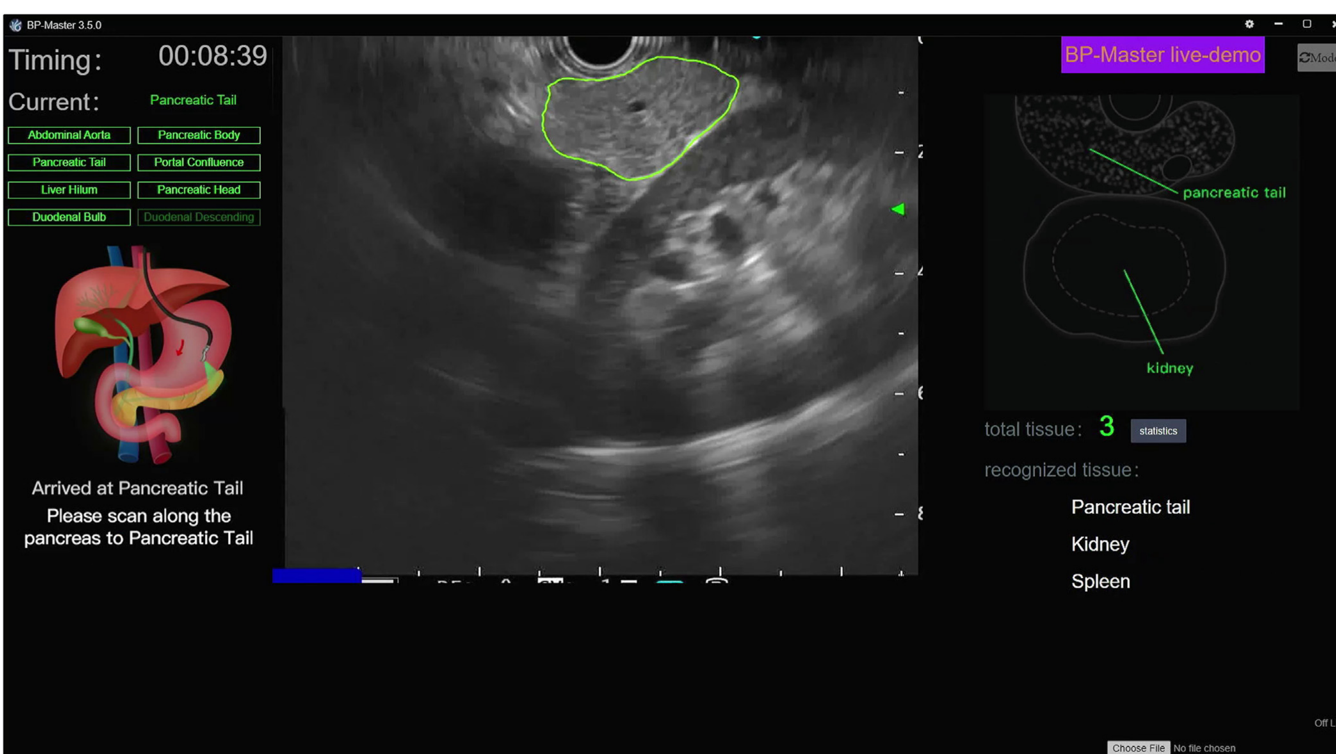

Figure 3. Identification and outline of the pancreatic tail in relation with the left kidney by the artificial intelligence system.

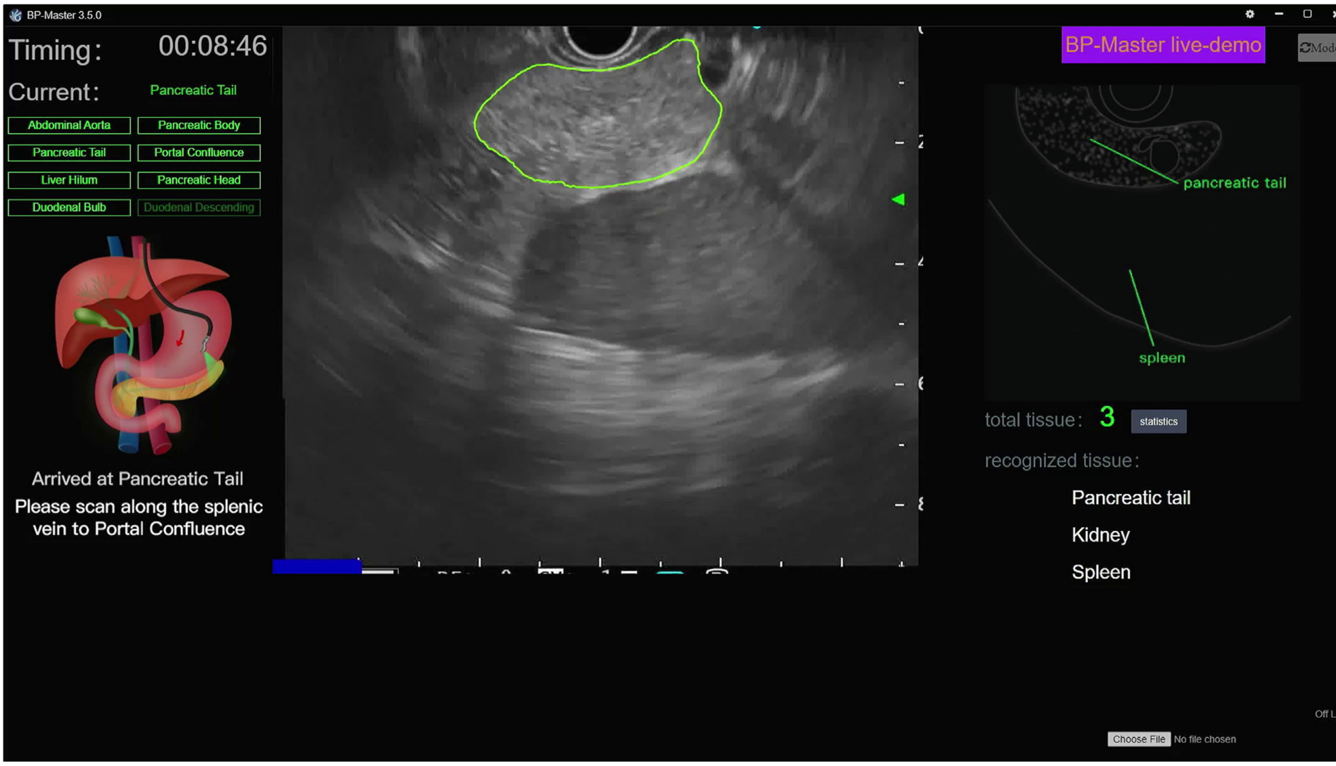

Figure 4. Identification and outline of the pancreatic tail in relation with the spleen by the artificial intelligence system.

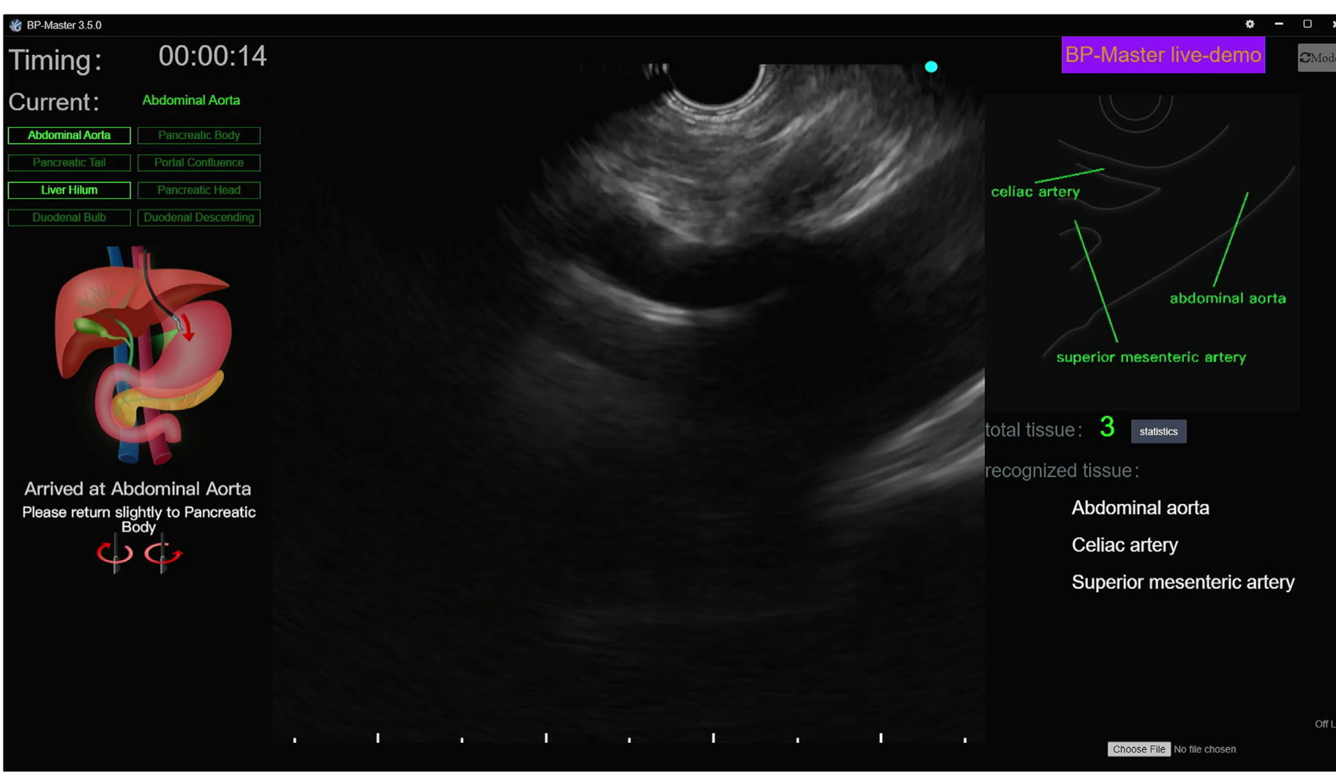

Figure 5. Identification of the abdominal aorta with the celiac trunk and superior mesenteric artery take-off by the artificial intelligence system.

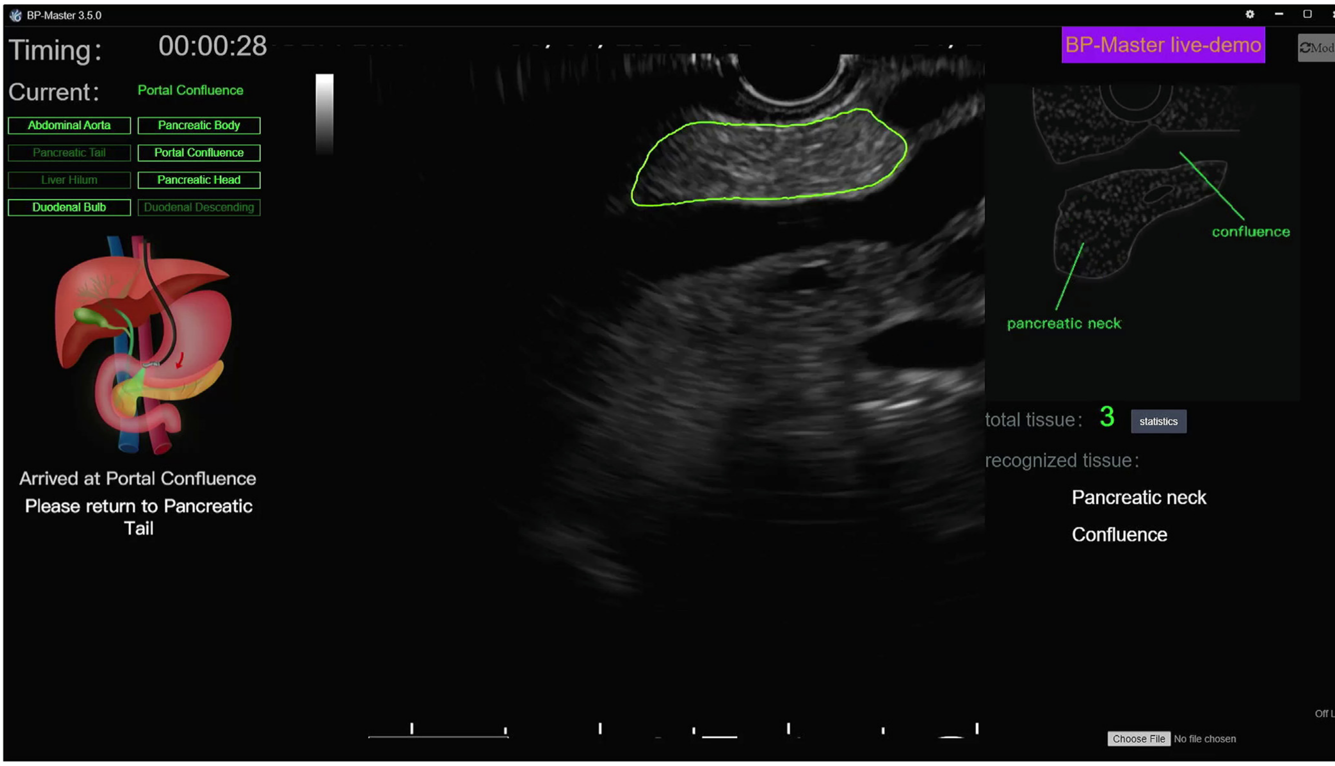

Figure 6. Identification and outline of the pancreatic neck together with the spleno-mesenteric-portal vein by the artificial intelligence system.

Figure 7. Endoangel system device.

stomach body, the AI EUS system correctly recognized the pancreatic neck and the portal confluence. However, probably because of the presence of common bile duct dilatation, the liver hilum initially was not recognized correctly. After activation of color Doppler, adequate identification of the portal vein and the common bile duct at the live hilum was obtained. Correct identification of the pancreatic body along the splenic vessels and of the pancreatic tail along the left kidney and spleen was demonstrated. From the duodenal bulb, recognition of the pancreatic head and, after color Doppler activation, of the common bile duct was obtained including its automatic diameter measurement. The hypoechoic mass of the pancreatic head was not recognized, because the system currently does not recognize pathologic alterations of any kind.

CONCLUSION

The present AI EUS DCNN-based system (Fig. 7) is able to correctly identify EUS anatomical landmarks. In the near future, this system might play an important role in EUS training and quality control. Furthermore, many other features might progressively be added with the next ideal step being identification of pathologic alterations. However, the possibilities are countless, including tissue acquisition guidance and enhanced pathologic diagnosis.[6]

PATIENT CONSENT

The patients in this article have given written informed consent to publication of the case details.

DISCLOSURE

All authors disclosed no financial relationships.

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REFERENCES

1. Kuwahara T, Hara K, Mizuno N, et al. Usefulness of deep learning analysis for the diagnosis of malignancy in intraductal papillary mucinous neoplasms of the pancreas. Clin Transl Gastroenterol 2019;10:1-8.
2. Marya NB, Powers PD, Chari ST, et al. Utilisation of artificial intelligence for the development of an EUS-convolutional neural network model trained to enhance the diagnosis of autoimmune pancreatitis. Gut 2021;70:1335-44.
3. Zhang MM, Yang H H, Jin ZD, et al. Differential diagnosis of pancreatic cancer from normal tissue with digital imaging processing and pattern recognition based on a support vector machine of EUS images. Gastrointest Endosc 2010;72:978-85.
4. Zhang J, Zhu L, Yao L, et al. Deep learning-based pancreas segmentation and station recognition system in EUS: development and validation of a useful training tool (with video). Gastrointest Endosc 2020;92:874-85.e3.
5. Yao L, Zhang J, Liu J, et al. A deep learning-based system for bile duct annotation and station recognition in linear endoscopic ultrasound. EBioMedicine 2021;65:103238.
6. Khalaf K, Terrin M, Jovani M, et al. A comprehensive guide to artificial intelligence in endoscopic ultrasound. J Clin Med 2023;12:375.