Endoscopic ultrasound-guided placement of fiducial markers using a novel "wet-fill technique" without a bone wax seal

Endoscopic ultrasound (EUS)-guided placement of fiducial markers for image-guided radiation therapy of gastrointestinal malignancies is usually accomplished by backloading a 22-gauge EUS-fine needle aspiration (FNA) needle with a thinner gold fiducial marker and sealing the needle tip with bone wax [1–3]. We describe a novel "wet-fill technique" for loading a fiducial marker into a needle and placing it in a tumor under EUS guidance that avoids the use of bone wax. The new technique has been used in one patient with pancreatic cancer and three patients with esophageal cancer.

A 22-gauge EUS needle (BNX system; Beacon Endoscopic, Newton, Massachusetts, USA) is loaded with a 0.35-mm × 1-cm gold coil fiducial (Visicoil; IBA Dosimetry, Schwarzenbruck, Germany) in the following manner: (i) the EUS needle tip is submerged in sterile saline (**Fig. 1a**); (ii) the stylet is slowly retracted 10 cm to fill

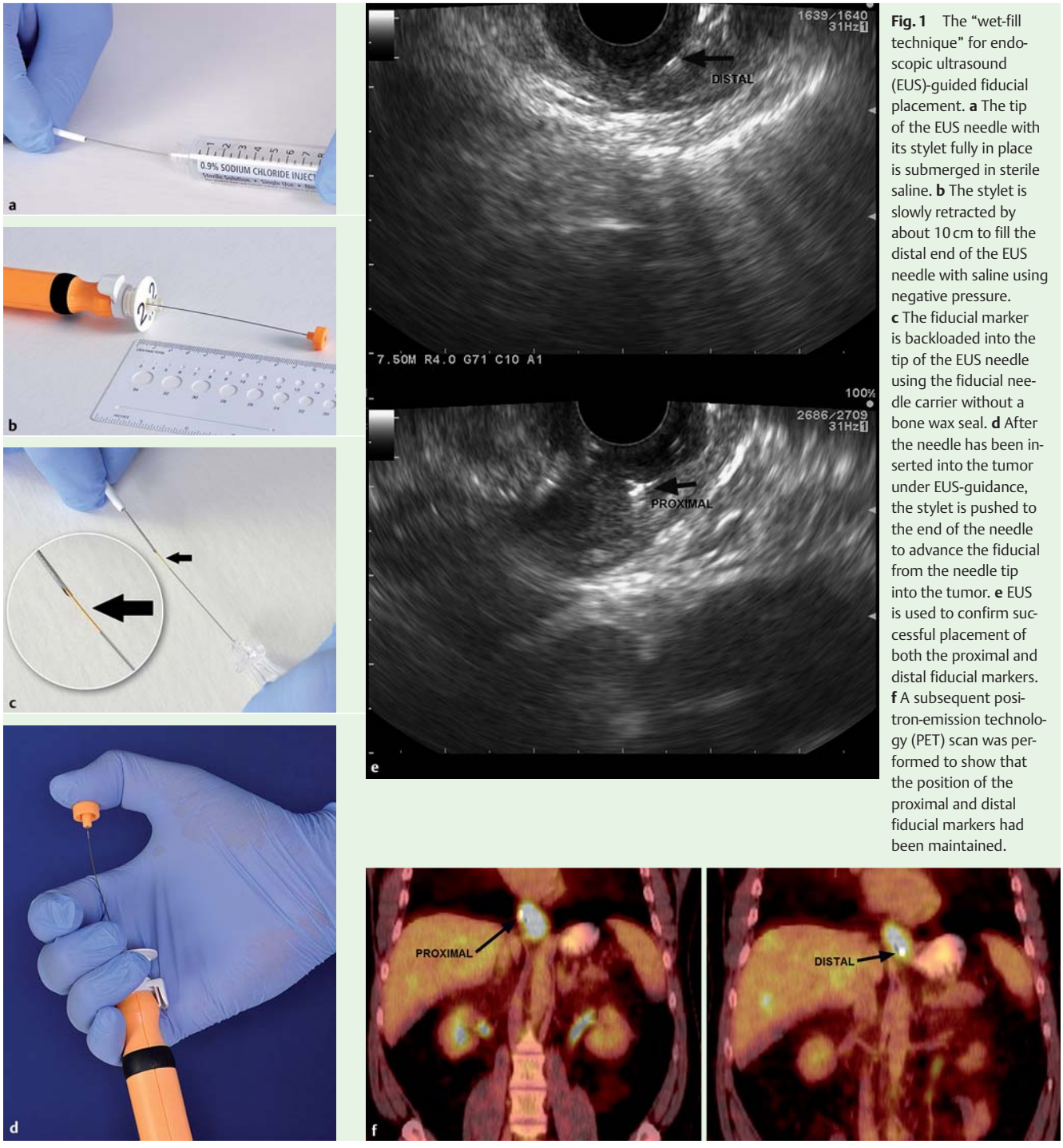

Fig. 1 The "wet-fill technique" for endoscopic ultrasound (EUS)-guided fiducial placement. **a** The tip of the EUS needle with its stylet fully in place is submerged in sterile saline. **b** The stylet is slowly retracted by about 10 cm to fill the distal end of the EUS needle with saline using negative pressure. **c** The fiducial marker is backloaded into the tip of the EUS needle using the fiducial needle carrier without a bone wax seal. **d** After the needle has been inserted into the tumor under EUS-guidance, the stylet is pushed to the end of the needle to advance the fiducial from the needle tip into the tumor. **e** EUS is used to confirm successful placement of both the proximal and distal fiducial markers. **f** A subsequent positron-emission technology (PET) scan was performed to show that the position of the proximal and distal fiducial markers had been maintained.

the distal end of the needle with saline (**Fig. 1 b**); (iii) the fiducial is backloaded into the needle tip using a Visicoil needle carrier (**Fig. 1 c**) and no bone wax seal is used; (iv) the needle is passed through the working channel of a linear echoendoscope (GF-UC140P; Olympus America, Center Valley, Pennsylvania, USA) and inserted into the tumor under EUS guidance; (v) the stylet is then pushed to the end of the needle to advance the fiducial into the tumor (**Fig. 1 d**). In all our cases, the fiducials remained stable in the needle until deployment, which was confirmed by EUS after placement (**Fig. 1 e**); and subsequent positron-emission technology (PET) scans showed no signs of delayed migration (**Fig. 1 f**).

Our report shows the feasibility, safety, and reproducibility of this novel wet-fill technique for EUS-guided fiducial placement. The surface tension created by the saline is sufficient to hold the fiducial in place within the needle lumen. The potential advantages of eliminating the bone wax seal using our technique are: reduction in the chances of fiducial placement failure and the crumpling effect that may be caused by excess bone wax; elimination of accidental needlestick injury when sealing the sharp EUS needle tip with bone wax; reduction in the material costs; and avoidance of the possible complication of granuloma formation following implantation of bone wax into tissue [4].

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