A simple ex vivo, biologic ERCP training model for sphincterotomy

The key therapeutic intervention during endoscopic retrograde cholangiopancreatography (ERCP) is sphincterotomy, but lack of training and experience leads to a higher risk of complications [1,2]. Herein, we present a simple, reproducible, easy-to-build, ex vivo, ERCP model for the training of sphincterotomy using standard sphincterotomes and a needle knife.

The model is based on incorporating one or more chicken hearts into a pig stomach (Fig. 1, Fig. 2, Fig. 3, Video 1). The native pig papilla has some limitations for sphincterotomy training, mainly because of its awkward location in the bulb compared with the second duodenum in humans. To solve this issue, we previously created a model in which the pig stomach was “duodenalized” to resemble the duodenal sweep in humans [3]. The duodenalization overcame the common position problems when performing ERCP in intact pig stomachs, which are large and j-shaped. In a further development of

**Fig. 1** Chicken hearts serve as ideal models for papillae. Their shape and anatomy resemble true ampullae. a The ventricle and aorta are perfectly suited to create a "bile duct" channel. b The chicken hearts can be cut in half to create smaller "papillae." c The ventricle can be punctured to create a papillary orifice. d An implanted papilla. e Stent inserted into implanted papilla.

**Fig. 2** The "neo-papilla" is attached to a pig stomach using 2-0 silk sutures (a–c).
the model, as presented herein, several papillae were implanted into various parts of an intact stomach, thus permitting the endoscopist to practice sphincterotomy in different positions. The model is built using four key steps: 1) pig stomach, 2) creation of several “neo-papillae” using chicken hearts, 3) implantation of papillae into various locations of the stomach, and 4) placement of the ex vivo model in a plastic container (Fig. 1, Fig. 2, Fig. 3, Video 1). An essential step in the creation of the papilla opening is insertion of a thick needle through the chicken aorta and puncture of the heart apex (Fig. 1, Video 1). Attachment to the stomach is achieved using 2–0 silk sutures (Fig. 2, Video 1). Endoscopic sphincterotomy can then be performed using a pull-type sphincterotome (Fig. 4, Video 1). This is the first report of performing precut sphincterotomy in an ex vivo ERCP model.

In summary, this model is novel and useful for various reasons. First, it can be reproduced with ease, as the animal visceral parts are easily obtainable. Second, it is inexpensive, enabling endoscopists in any part of the world to reproduce and use the model for training. Third, the papilla has a natural appearance, with strong resemblance to a “real-life” clinical scenario, and cutting the tissue allows the endoscopist to gain experience in the various types of currents used for sphincterotomy. In addition, there is no better replacement for cutting on real tissue when learning a delicate technique such as sphincterotomy. We believe that, for ethical reasons, endoscopists engaging in therapeutic interventions should first obtain experience in ex vivo models before performing the procedure in humans [4]. Finally, to the best of our knowledge, this is the first report of performing precut sphincterotomy in an ex vivo ERCP model.

Competing interests: None

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