Repair of esophageal perforation: a new technique

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Despite progress in surgical technique and nutritional support, esophageal perforation remains associated with high morbidity and mortality.[1] We describe a new technique used to repair an esophageal perforation in a patient with a gunshot injury.

Case report

A 39-year-old woman was admitted to our shock trauma centre for the management of abdominal and thoracic trauma caused by penetrating gunshot wounds. Thoracic and abdominal computed tomography showed multiple fractures of the spleen and hemoperitoneum, a small lesion of the upper left kidney, a fracture of the eleventh left rib and a diaphragmatic injury. Forty minutes after admission to the hospital, the patient underwent a splenectomy. We simply sutured the small, superficial lesion on the upper pole of the kidney. The 2-cm hole in the diaphragm was treated by an interrupted horizontal suture. A hole measuring about 2 cm in diameter was detected on the posterior wall of the gastric fundus; tissue at the edges of this gastric wound was normal, so a primary closure was performed in layers. A second hole on the anterior wall of the abdominal esophagus, also with normal tissue edges, was repaired by a new technique. We sutured the mucosal–submucosal layer transversely to the longitudinal axis of the esophagus, whereas the muscular layer was sutured longitudinally; in both cases, we used an interrupted suture of 4–0 Vicryl. A nasogastric tube was placed for 10 days. Findings on esophagography, performed 2 weeks postoperatively were normal. Three weeks after surgery, the patient was discharged; at 24 months' clinical follow-up, no complications were noted.

Discussion

Esophageal perforation that is diagnosed early and is not associated with intrinsic esophageal disease should be treated with primary repair of the defect, with wide drainage. Suturing is the ideal procedure because it permits fast healing by primary intention and early enteral nutrition. The success of the repair depends on the extent of the débridement of nonviable tissues and meticulous repair by 2 longitudinal, separated, interrupted suture lines of the mucosal and muscular layers. This double-layer closure has higher bursting wall tension and shows better healing than a single layer.[2] In our technique, the suture lines are orthogonal, with crossed double suture lines. The mucosal layer was closed by a transverse suture to the longitudinal axis of the esophagus; the muscular layer was closed by a longitudinal suture (Fig. 1). To record a qualitative analysis of the mechanical forces involved in the stability of this suture technique, we have compared the esophagus to a cylindrical hollow tube with a circular hole. Moreover, for simplicity's sake, the 2 types of suture will initially be considered individually. Distension of the esophageal wall during the propagation of a peristaltic wave represents the source of highest tension for the suture. During the dilatation, the pressure inside the esophagus is balanced by the elastic response of the wall. On the longitudinal suture, the mechanical stress is applied in the same direction but opposite to the transverse tensile force due to the stitches. This causes a widening

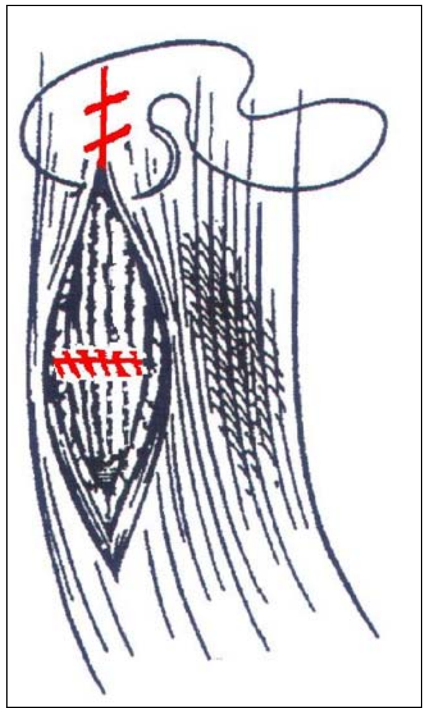

FIG. 1. Schematic diagram showing the double-crossed suture.

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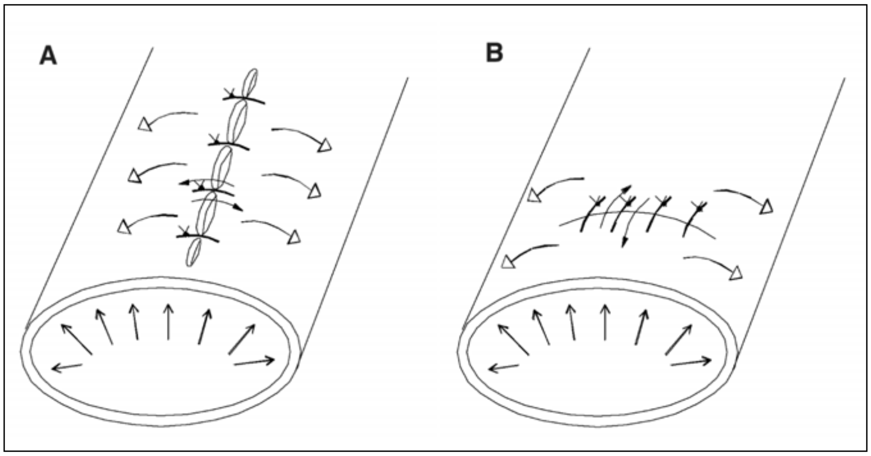

FIG. 2. Schematic diagram of the tension strength involved in (A) the longitudinal suture and (B) the transverse suture. Black arrows are static tension strength of the stitch; white arrows represent the direction of tension force during esophageal distension by the peristaltic wave; open arrows represent the direction of pressure force inside the esophagus during dilatation.

of space between the stitches (Fig. 2A) because, far from the stitches, the force closing the wound is not equal to that tending to open it.[3] Thus the mechanical stress on the muscular longitudinal suture requires balancing by straining muscular fibres hooked by suture stitches, whereas balance in the mucosal longitudinal suture is achieved by the tensile strength of each stitch on the mucosal tissue. In contrast, on the mucosal transverse suture, the distension of the esophageal wall determines the mechanical stress orthogonal to the strength applied by suture stitches (Fig. 2B). In this way, the resultant strength of the suture line has some advantage with respect to border adhesion. Compared with similar wounds oriented perpendicular to the tension line, wounds parallel to the tension line require less force and work to close initially.[4] Under distension, a double longitudinal suture may allow small widenings in the wall, which can become fistulous. This risk is minimized with our new technique; in fact, muscular suture widening can be protected against by the underlying integrity of the mucosal layer and vice versa. This crossed suture causes a static stress in connective layers between the mucosal and muscular planes. Under static conditions, the strength lines present a probable spiral course with the axis perpendicular to the separation surface between the 2 tissue layers.[4] Generally, the length of the esophageal perforation does not limit use of the suture, even if, in a suture longer than 5 cm, the suture has to be reinforced by a flap. Our new technique is recommended to prevent esophageal stricture when the esophageal perforation lesion is less than 2 cm long.

Competing interests: None declared.

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