

Artificial perforations of the stomach in pigs and rats and their covering by the abdominal wall

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ABSTRACT: The stitching of artificially created opening in the stomach to the parietal peritoneum has been experimentally examined so that the missing resected part was covered with the abdominal wall. Stomach contents were in direct contact with the peritoneal surface. In contradiction to common opinions (the rise of peritonitis and subsequent death) all experimental animals (six pigs and ten rats) survived the operation without any apparent complications. Within eight weeks following the laparotomy ("a second look"), the artificial perforation was narrowed down partly with outgrown gastric mucosa and partly with new generated fibrous tissue. The results of this strange experiment turn down common convictions about development of generalised peritonitis. The experiments are not an end in itself but offer possible use in a clinical experiment in humans. A casuistic of one patient with the perforated ulcer-carcinoma is discussed in this report.

Keywords: pig; rat; stomach; artificial perforation; surgical intervention

The first successful trial to stitch a perforated gastric ulcer was carried out by Ludwig Heusner in the year 1892 (cit. Lau and Leow, 1997; Martin, 1992). Gradually a number of authors increased the use of the ulcer stitching in one or more layers, some of them excised the ulcer and sutured the incurred defect. If narrowing-down took place, the situation was solved by means of pyloroplasty surgery or by formation of enteroanastomosis. Where the ulcer is closed with stitches some authors applied the tamponade with a tip of omentum major. The omentum inserted in the perforation opening was secured in this position by stitching through. Later on the stomachic resections approached the mentioned procedures, however, the implementation of such an intervention requires the early determination of perforation. In desperate situations when the ulcer could not be closed by either stitching or by resection of stomach, the gastrostomy was carried out at a point of perforation. In extraordinary situations we may consider the closing of perforation with stitching the gallbladder fundus in the perforation opening (cholecystogastrostomy) or the stitching of perforated stomach into the abdominal wall. The latter intervention, i.e. the stitching of perforation into the abdominal wall, was been described in an earlier book by Jirásek (1958). He attributed this method to Braun, however, Braun has not been included in the list of references. We searched for this type of operation in the literature available, however, with the exception of the mentioned incomplete reference nobody

was dealing with this unusual intervention. We therefore decided to elucidate the problems in an experimental way.

The experiments were carried out on 6 laboratory miniature pigs at the weight of 15–30 kg and 10 rats of the Wistar strain at the weight of 270–320 g. The technique of operation was uniform. In a complete anaesthesia we opened the peritoneal cavity on the middle line in the epigastrium. We established the model perforation on the gastric body in the region above the angle of stomach. Among four supporting stitches we excised the fore wall so obtaining an opening with a diameter 5–7 cm for pigs and 1.5 cm for rats. We seamed the opening around the whole periphery with single stitches. Then we stitched by degrees the fore stomach wall with a perforation point to the parietal peritoneum with single stitches. In the stomach we took the seromuscular layer, on the abdominal wall the serous membrane and the subserous fibres. Thus, we attached knotting stitches to the stomach wall over the periphery of perforation to the abdominal wall, namely the left part of the operation wound. The abdominal cavity was gradually closed in layers. For 2–3 days following the operation the animals were administered liquid food. We observed the animals clinically and by histology. After 8 weeks we excised from laparotomy a part of abdominal wall with the original perforation opening (biopsy in pigs). As for rats, we killed them and took the same part of stomach for the post-mortem examination. The material was stained histologically with haematoxylin-eosin.

All animals have survived in good condition. Around the point of the stomach stitched to the abdominal wall, there were some adhesions of the omentum major. The peritoneal cavity was found to be without any adhesions. The findings on the stomach at the point of perforation were similar for pigs and rats. In both groups of animals the perforation opening was narrowed by about 1/3 in size. The stomachic mucous membrane was gradually narrowed down and passed to the point of defect in the wall with a sharp line. Only in the bottom part was the fibrous tissue partly defibred. The abdominal wall was of stiffer consistency without any demonstrable inflammatory changes. No dehiscence has been demonstrated at the point of suturing.

The histological changes could be divided into changes at the edge of defect and into its bottom part (Figure 1). At the edge of defect the mucous membrane passed in the bottom part of defect with a sharp line. The mucous layer was mildly attenuated. The foveolae gastricae were larger and shallower. The glandulae gastricae fell into their bottom part. In the mucous layer no lymphatic follicles were observed. The muscularis mucosae towards the bottom part of perforation was irregularly arranged and in the submucous fibres there was almost a lack of lymphatic follicles. Here and there the muscularis mucosae linked up to the outer muscular layer. The bottom part of defect was covered with a fibrous layer. The collagen fibres, irregularly arranged, were joined to the stiffer fibrous layer, covering the fibres of striated muscles. The fibres on the bottom part of defect comprised only a smaller number of fibrocytes. The collagenous fibres prevailed.

The perforations of gastroduodenal ulcers in old patients represent serious sudden abdominal accidents. Even though in the last years the metabolic and anaesthetic care has been substantially improved, the risk to geriatric pa-

tients remains high. The patients even with marked and long-term troubles have been hospitalised very late as far, to be subjected to detailed examinations. Besides regular surgical interventions we recorded in the old literature an interesting approach that is based on a stitching of ulcerous lesions to the abdominal wall. To our surprise, the more drastic simulating experiments with extensive stomach openings did not endanger the life of our experimental animals. This experience has also been confirmed in the case of 81-year old patient (surgeon K.F.) where the laparotomy was applied as late as 12 hours from the beginning of perforation of mediogastric ulcer-carcinoma, verified histologically as an adenocarcinoma (histology J.T). With regard to the developed diffuse peritonitis, only the simplest and most considerate intervention could be chosen. To avoid the penetration of carcinoma in the periphery we chose the ischaemization by means of a series of stitches over the whole periphery of carcinomatous focus. Stitching into the abdominal wall was chosen in an extreme distress. We carried out this procedure also for the reason that the excision of the whole focus could produce a considerably large defect complicating the situation. The suturing of a part of stomach with perforation to the abdominal wall resulted in the healing. The patient survived for the period of 3 years without any difficulties (her death occurred due to cerebral vascular apoplexy).

The results of this experimental study and of one clinical case outlined several yet not answered questions. Why is not the stomach content harmful (high acidity, absence of pathogenic microbes, relative intactness of abdominal wall)? The experimental results could be verified in an extremely desperate situation on a clinical experiment that was the only solution to save the patient. In this case, in addition, the problem of ulcer-carcinoma was also facilitated by ischaemization and thus limited propagation of

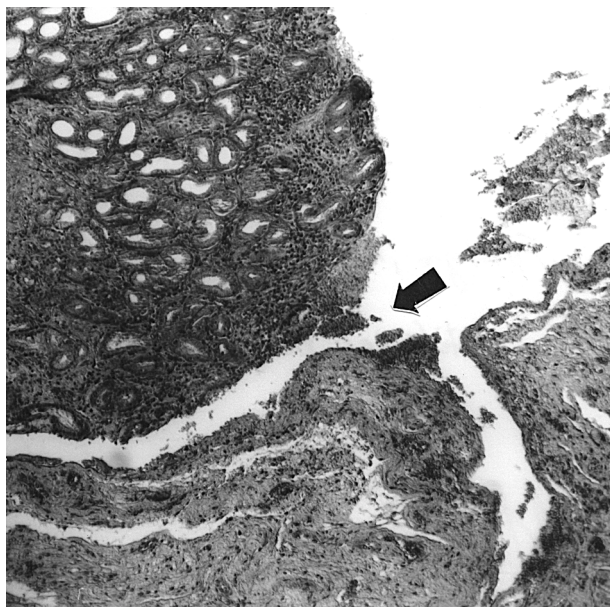


Figure 1. The junction site between a margin of the artificial stomach opening and abdominal wall. The arrowhead – the edge of the stomach. Two months after operation (haematoxylin-eosin, enlarged 135 times)

the tumour. The ischaemia was probably produced during stitching and tightening of sutures around the carcinoma base. Similar experiments with ischaemia-induced destruction (by devascularization, devitalization) of different intestinal segments did not endanger the life of experimental pigs (Fortýn *et al.*, 1985, 1989).

The clinical case and the experimental experience have shown that even the exceptional operational solutions of perforating ulcers have their validity if the whole scale of current interventions employed will be shown as quite inapplicable.

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Received: 00–11–27

Accepted after corrections: 01–04–05

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