

W. OLSZEWSKI, T. KRASSOWSKI

MORPHOLOGICAL STUDIES ON THE HEALING OF THE TRANSECTED VATER'S PAPILLA

Department of Experimental Surgery, Polish Academy of Sciences, Warsaw, and
Department of Histology, Medical Academy, Warsaw

The process of healing of the transected Vater's papilla was studied in 10 dogs. The progress of healing was checked in dogs killed successively during a period of 1—120 days from the operation. On the average the healing was completed 10 days after the operation. In the area of incision the mucosa of the duodenum and that of the common bile duct formed a union preventing thus the margins of transected sphincter to join together. Therefore no constricting scars developed.

The extending therapeutic indications for incising the papilla of Vater and the sphincter of Oddi (6, 8, 10, 11, 13, 17, 22, 24) as well as the existence of a great variety of methods in the performance of this operation (1, 4, 12, 17, 21) make it necessary to study thoroughly the healing process of the transected papilla.

In a previous experimental work (20) it has been shown that independently of the surgical method used, already after 2 months a durable concretion of the common duct mucosa with that of the duodenum occurred, with no cicatricial stenosis. This was observed in cases of simple sphincterotomy as well as after suturing the mucosa or after healing with a drain left in the common bile duct. It was our intention now to examine histologically the progression of healing of Vater's papilla after sphincterotomy and to establish what factors influence the formation of a durable mucosal union without the appearance of cicatricial stenosis.

MATERIAL AND METHODS

Our studies were carried out on 10 mongrel dogs. Laparotomy was performed under general anesthesia, then the duodenum and the papilla of Vater with Oddi's sphincter were transected longitudinally, on a 10 mm long space. The incision was left without sutures and without drain. The animals were killed after 1, 2, 4, 7, 10, 14, 21, 28, 60 and 120 days. Fragments of the duodenum with the papilla were taken, fixed in 10% formalin, embedded in paraffin and

10 micron thick sections for microscopic examination were prepared. The sections were stained with hematoxylin and eosin. To ascertain the effects of the operation the sections were made perpendicularly to the incised common bile duct, at half length of the surgical incision. A schematic drawing of a cross section is shown in Fig. 1. On such cross sections the condition of the transected muscle fibers of the sphincter as well as the progress of the union of the mucosa of the common bile duct and that of the duodenum could be evaluated.

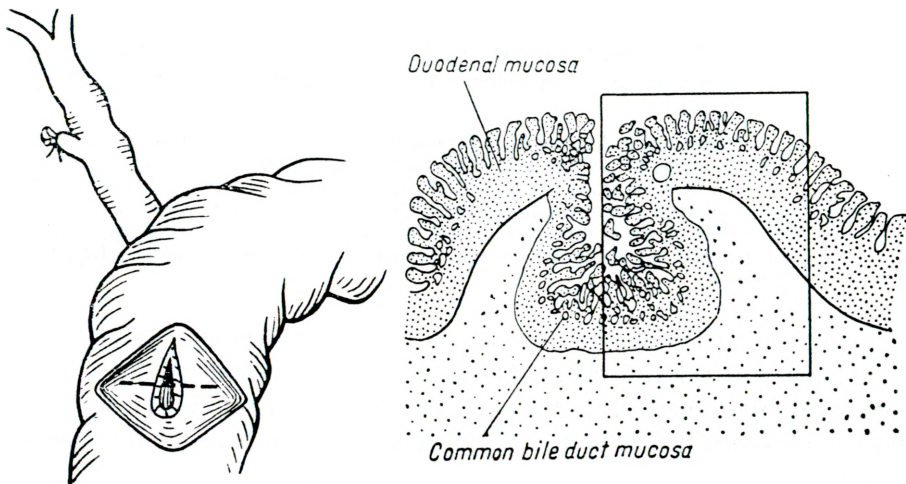


Fig. 1. On the left: the site where the section was taken from the papilla (broken line), on the right: a schematic drawing of a microscopic preparation from the transected papilla. The rectangle encloses the field where the union of the mucosa was observed.

RESULTS

On the first day after the operation, between the mucosa of the duodenum and that of the common bile duct a broad band of young connective tissue could be observed with necrotic changes, numerous hemorrhages and inflammatory infiltrations (Fig. 2). This band corresponds to the damage due to surgical trauma. Tissue necrosis between both mucosae extended deep into the duodenal muscular layer. Within this area, transected muscle fibers of the circular part of the sphincter of Oddi could be observed along with the sectioned muscle fibers of muscularis mucosae seen on the side of the duodenum. Similar tissue reactions beyond the site of the surgical trauma were seen in the adjacent areas of the submucosa. The mucosa and the muscular layer beyond the area of the surgical trauma presented no changes.

On the second day after the operation the findings were similar to those on the first day. A band of young connective tissue was seen filling the tissue defect at the point of transection of the mucosa and numerous wandering cells of the connective tissue were noticed in the neighborhood.

On the fourth day after operation, the onset of union formation between the mucosae was observed (Fig. 3). The surface of the developing union began to be covered by a young cuboid epithelium expanding from the duodenum and the



Fig. 2

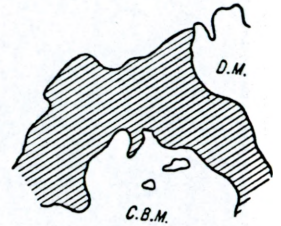


Fig. 2a

Fig. 2, Fig. 2a. A microscopic preparation of the transected Vater's papilla on the first day after the operation. Higher in the picture the duodenal mucosa (D. M.) is visible, below the common bile duct mucosa (C. B. M.), in the middle a band of the necrotic tissue (hatched area).

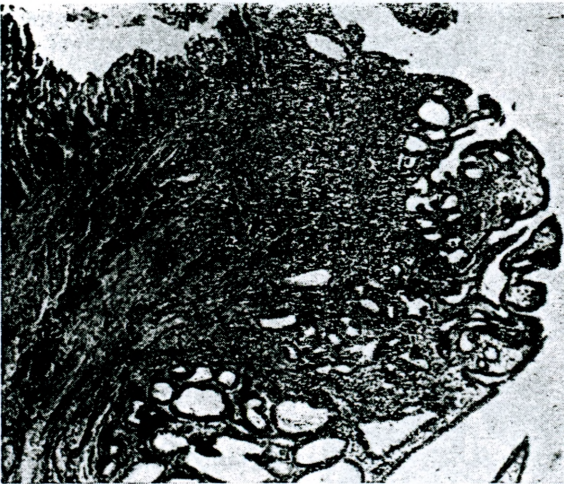


Fig. 3

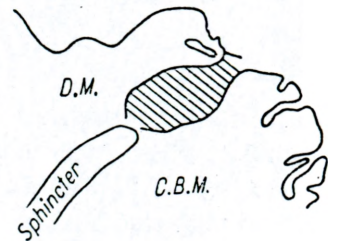


Fig. 3a

Fig. 3, 3a. A microscopic preparation of the transected papilla on the fourth day after the operation. The area between the mucosae is filled by young connective tissue, the epithelium begins to cover its surface. The fibers of Oddi's sphincter are visible. The duodenal villi are flattened.

common bile duct. The print of union of the mucosae was filled by connective tissue in which stumps of the muscle fibers of the duodenal muscularis mucosae and fibers of the sphincter of Oddi could be detected. Lymphocytic infiltrations were seen in the neighboring duodenal villi.

On the seventh day after operation the site of incision showed no evidence of a traumatic destruction, and the macroscopic picture presented a direct union of the mucosa with only slightly damaged surface of the villi (Fig. 4).



Fig. 4

Fig. 4, 4a. A microscopic preparation of the transected papilla on the seventh day after the operation. The band of connective tissue between the mucosae is distinctly narrower. Some small cell infiltrations are seen in the villi. Beginning mucosal union.

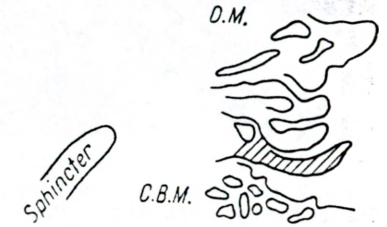


Fig. 4a



Fig. 5

Fig. 5, 5a. A microscopic preparation of the transected papilla on the tenth day after the operation. The healing is completed. The union of the mucosae is completed and covered by epithelium.

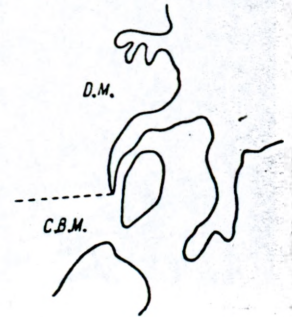


Fig. 5a

At the point of the tissue incision in the submucosal layer of the duodenum, a thin connective tissue scar was visible. No morphological changes could be detected in the mucosa.

On the tenth day after operation the histological picture was that of a completed healing process (Fig. 5). Between the adherent mucosae, no fissures could be detected and only in the submucosa slight bands of connective tissue were present, witnessing to former damage.



Fig. 6. A microscopic preparation of the transected papilla 2 month after the operation. The mucosae are thoroughly united, no connective tissue scar is visible.

The morphological findings after 14, 21, 28, 60 (Fig. 6) and 120 days resembled those detected on the tenth day after operation.

DISCUSSION

The most important question for the surgeon is the possibility of scar formation at the site of incision, which might result in a renewed stricture of the orifice in the papilla. Most reports, clinical as well as experimental, prove that in 90% of the cases operated upon sphincterotomy gives good and persistent results. This is evidenced by the clinical improvement, the permanently reduced pressure in the common bile duct (2, 15, 16, 19) and the reflux of the duodenal content into the bile ducts (14, 15, 21). The number of reoperations because of a second stenosis of the papilla reported in the literature is small and their incidence does not exceed 8% (13).

In spite of this statement certain authors consider, basing on experiments on animals that sphincterotomy does not cause a permanent facilitation of bile flow (5, 7). According to their observations several weeks after the operation,

a scar is formed at the site of incision, constricting the edges of the sphincter and causing a secondary stenosis. The pressure in the bile ducts returns to the initial level in 5 days to 6 weeks.

The morphological observations in our experimental material seem to show that healing of the transected Vater's papilla takes place usually without the formation of a constricting scar. The process of healing progresses rapidly and lasts usually up to 10 days. The close union of the mucosa is permanent. The histological pictures obtained after 10 days did not differ morphologically from the pictures observed several months after the operation. As a result of healing of Vater's papilla after a simple transection, a good union of the mucosa of the duodenum and the common bile duct was found, sometimes accompanied by the formation of only a slight connective tissue band. The histological picture seems to indicate that the anatomical conditions produced as a result of the operation reestablish a free bile flow through Vater's papilla.

Basing on these experiments it seems that a sufficiently extensive sphincterotomy and a partial transection of the duodenal muscularis in agreement with the results of the anatomical investigations of *Boyden* is necessary to ensure a free bile flow through the papilla of Vater into the duodenum (3). A condition of the permanent patency is a good direct union of the mucosa of the duodenum and the common bile duct. A thorough union of these mucosae prevents the formation of an extensive granulation tissue, which during healing may result in constriction of the edges of the transected sphincter impairing the patency of the orifice.

CONCLUSIONS

1. The healing of the papilla of Vater, incised on a 10 mm long space in a dog lasts usually 10 days.
2. At the site of transection union of the duodenal mucosa with that of the common bile duct develops in such a way that the edges of the transected sphincter of Oddi cannot meet.
3. A rapid and thorough union of the mucosae is a condition of a permanent broad orifice of the common bile duct in the duodenum, after sphincterotomy.

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