

tion caused by Bidgood's operation. One died the 41st day from marked distemper. The remaining dogs were operated upon or sacrificed, recovering specimens from 33 to 107 days after operation. Three of these anastomoses were incidental to other operations. Double zero catgut mattress sutures on welded needles were used throughout. There were no symptoms of obstruction, no dilatation nor constriction from the diaphragm and no adhesions about the bowel as a result of anastomosis.

CONCLUSIONS.

An instrument has been devised for cutting purse-string sutures used with satisfaction and precision in 87 operations. It cuts without tension on the suture material; it is simple; it can be sharpened readily and repeatedly; the needles are light and do not pull on the purse-string sutures.

Twenty-eight consecutive operations with removal of specimens from zero hours to 44 days, have been performed with a minimum of adhesions with no signs of obstructions and with no death that could be attributed to the operation. Eight consecutive operations with specimens recovered from 33 to 107 days have been performed without a death from the operation, and with no adhesions. In this type of anastomosis on the small bowel, the sutures must be taken close to the purse-string sutures and the lumen should be opened at operation. Aseptic end-to-end anastomosis of the bowel can be safely and easily performed by this method.

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Healing of aseptic end-to-end intestinal anastomoses by the author's method.

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A study was made of specimens of 86 end-to-end anastomoses performed on dogs using a revolving tubular knife for cutting ligatures or purse-string sutures placed about the closed abutted ends of severed bowel after enterorrhaphy was practically complete. Several types of silk or catgut sutures were used. Stitches

approximating the serous surfaces were laid at various distances from the occluding ligatures or purse-string sutures beyond which, at different lengths, the bowel was severed by electric cautery or by cutting and carbolizing. In some cases the serous and muscular coats were stripped back and the ligatures were placed about the submucosa or near the cut edges. The bowel was cut perpendicularly to the long axis, slightly obliquely, or at an angle of 45° .

Rapidity of healing depends upon (1) the amount of trauma or necrosis produced by severing the bowel and sterilizing the cut ends; (2) the proximity of the cut mucosal surfaces to each other at the tip of the intumescence; (3) the position and length of the apposed bowel walls at the intumescence; (4) the vascularity of the intumescence which largely depends upon the size, type, material and tightness of the sutures, and the angle at which the bowel is severed, and (5) the amount of infection about the area of anastomosis.

Cutting and carbolizing the stumps causes less extensive trauma, necrosis and hemorrhage to the bowel wall than does cauterizing thermally although, unless proper precautions are taken, there is more chance for soiling by the former method. Stripping back a sero-muscular cuff and ligating the mucosa and submucosa hastens healing but adds an unnecessary step to the operation.

The intumescenced walls agglutinated by fibrinoplastic exudate by the completion of the operation and they begin to retract immediately on being freed from their normal tension. If the intumescence is short the line may be practically straightened by the 8th day and completely straightened by the 21st day, but such rapid straightening is inadvisable. Other specimens show very slight thickening at the line of anastomosis by the 105th day. The size of the diaphragm largely determines the length of time for the intumescence to straighten out. When the diaphragm is very small the bridge is composed of a broad band of connective tissue. Two layers of sutures delay the straightening of the intumescence.

When the mucosal surfaces are in close proximity with slight destruction and good blood-supply the epithelium can be seen starting to cross the gap 48 hours after operation and it may be entirely covered across by the 7th day. The line of epithelium is of the embryonic, low cuboidal, undifferentiated type which may grow down from the surface of embryonic villi or out from the

glands. By the 21st day there is a thick covering of mucosa everywhere and by the 33rd day it has become normal in size and shape.

The *stratum fibrosum* and *granulosum* stretch across the gap made by the cut and the *stratum fibrosum* receives fibres from the submucosa and new connective tissue at the apposed surfaces. The *muscularis mucosæ* is found practically normal by the 68th day. The fibres join from either side and may receive fibres from the inturned longitudinal muscle.

The circular muscle is separated by a more or less thin line of connective tissue across which the muscle fibres never pass. The longitudinal muscle gradually disappears from the inturn, being replaced by connective tissue, but grows across from either side under the serosa, forming a continuous band at least by the 68th day.

The fibrinoplastic exudate becomes invaded with fibroblasts by the 3rd day and strong connective tissue bands are formed. These gradually thin out to narrow fibrous bands by the 107th day.

Silk sutures not entering the lumen may be drawn to one side during the process of the straightening of the inturn and may be found by the 104th day lying quietly without reaction beneath the serosa. Sutures entering the mucosa are walled about with leucocytes and a new epithelial layer from the glands begins to surround them by the 2nd day. *Stratum granulosum*, *stratum fibrosum* and *muscularis mucosæ* grow about the epithelial layer to restore the gland to its normal position. Silk sutures are found on the 68th day without reaction and extending from beneath the serosa out into the lumen. They may be found still hanging in the lumen by the 104th day. The No. 1 catgut purse-string sutures are absorbed or cast off into the lumen and are not found after the 7th day.

There is dilatation of the blood vessels in the inturn beginning within the first 22 hours and remaining until the 27th day. Tight sutures may cause anemia or infarction in the inturn thereby delaying healing. Sutures at mesenteric border do not threaten the blood supply at the free border if the bowel is cut slightly obliquely. Catgut sutures on ordinary needles cause more trauma and hemorrhage than those on welded needles. One layer of Halsted mattress sutures, when properly placed, is sufficient for safe end-to-end intestinal anastomosis.