

EFFECTS OF LYMPH STASIS ON HEALING OF RAT INTESTINAL ANASTOMOSIS

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ABSTRACT:

The effects of lymphatic drainage on ileal anastomotic healing using interrupted polyglycolic acid sutures were studied in rats after division and obstruction of celiac-mesenteric lymphatics, and the data compared with sham-operated controls.

In 4 of 20 rats with lymph stasis, but not sham-controls, anastomotic leakage was associated with generalized peritonitis and death. Histologic examination of the anastomotic site at 7 and 14 days revealed prolonged exudation with acute inflammatory reaction and less prominent granuloma formation where lymphatics were interrupted. Whereas foreign body giant cell reaction predominated at 14 days with lymph stasis, histiocytic and fibroblastic proliferation dominated in sham-controls.

The data suggest that an intact lymphatic system favors optimal intestinal healing and repair.

Healing of an intestinal anastomosis depends on both systemic and local conditions (1-3). Whereas the effects of arterial and venous flow, the type of suture material and operative technique have been widely examined (4-6), the role of the lymphatic system is rarely considered. On the other hand, many intestinal anastomoses are often carried out after removal of regional lymph nodes, oversewing of lymphatic trunks, and in the presence of inflammatory processes characterized by acute and chronic lymphangitis (7). Accordingly, we evaluated the effects of intestinal lymph stasis on the evolution of ileal anastomotic healing. In rats, celio-mesenteric lymphatics were divided and obstructed (8-10), and il-

eoileostomies constructed using polyglycolic acid suture material with minimal local tissue reaction (11,12).

MATERIALS AND METHODS

Forty male Wistar rats (~300g), fasted overnight, were anesthetized with an i.m. injection of Leptofen (0.4 ml) and laparotomy performed. Two groups were studied:

Group 1 (20 rats): Lymph stasis was induced by coagulating and severing celiac and mesenteric lymphatics, and cessation of lymph flow verified by dye injection (methylene blue) into regional lymph nodes.

Group 2 (20 rats): Sham operation was performed with identification and isolation but not interruption of celio-mesenteric lymphatics. Ten days later each rat underwent a second laparotomy and in Group 1 interruption of lymphatic flow was confirmed again by dye injection.

Thereafter, in both groups the small bowel was divided 15 cm proximal to the ileo-cecal valve and an end-to-end ileoileostomy performed using polyglycolic acid (6/0 atraumatic suture) with an interrupted inverting technique excluding the mucosa. Rats were then housed individually and nourished with standard meals beginning 24 hours after operation. Some rats in each group were killed at 7 days and the remaining rats at 14 days. After sacrifice, anastomoses were examined for leakage,

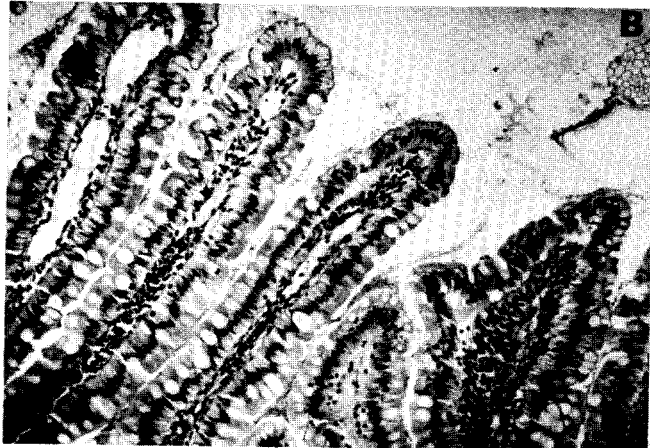
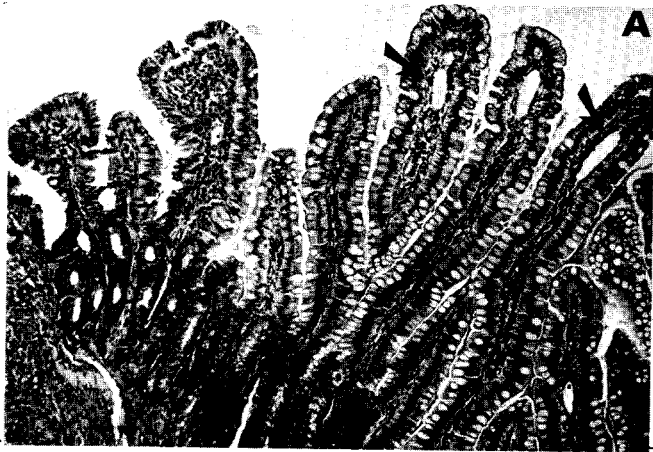


Fig. 1: Ileum in rat with lymph stasis. Note lymphatic dilatation in the mucosal layer (arrows). (A: 65x; B: 100x; H & E)

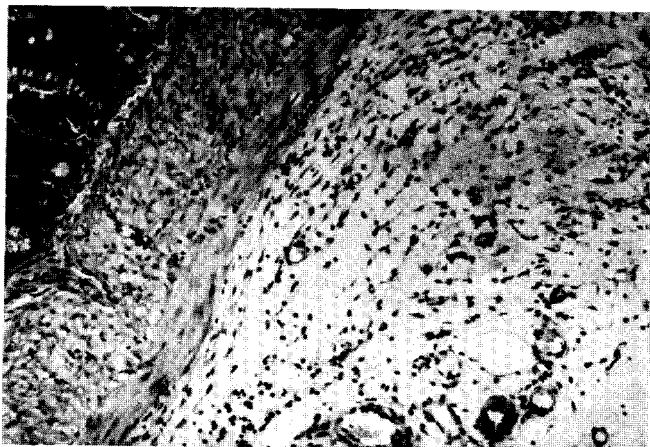


Fig. 2: Ileum in rat with lymph stasis. Note extensive edema of the submucosa. (100x; H & E)

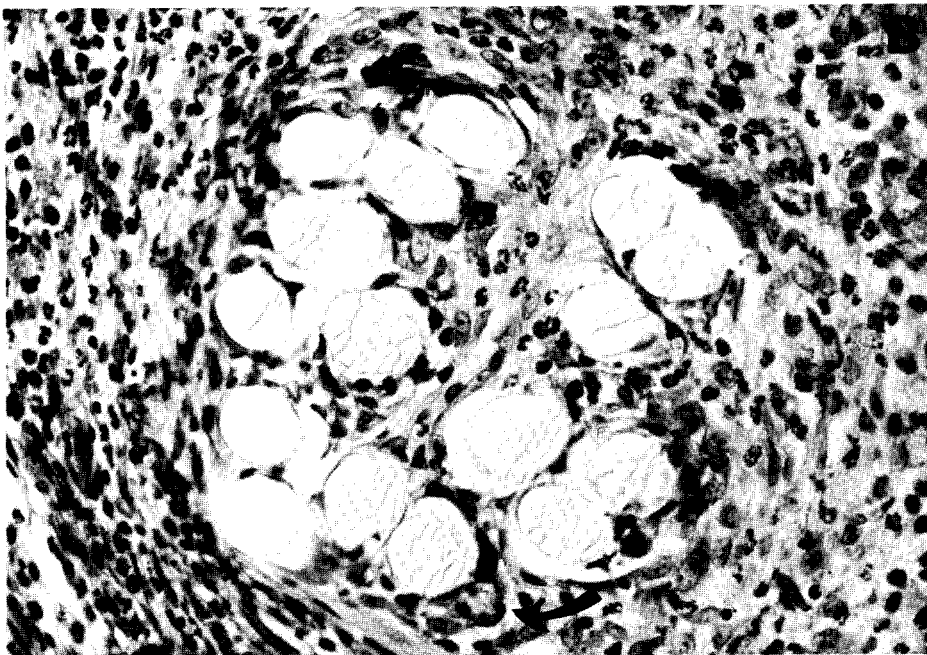
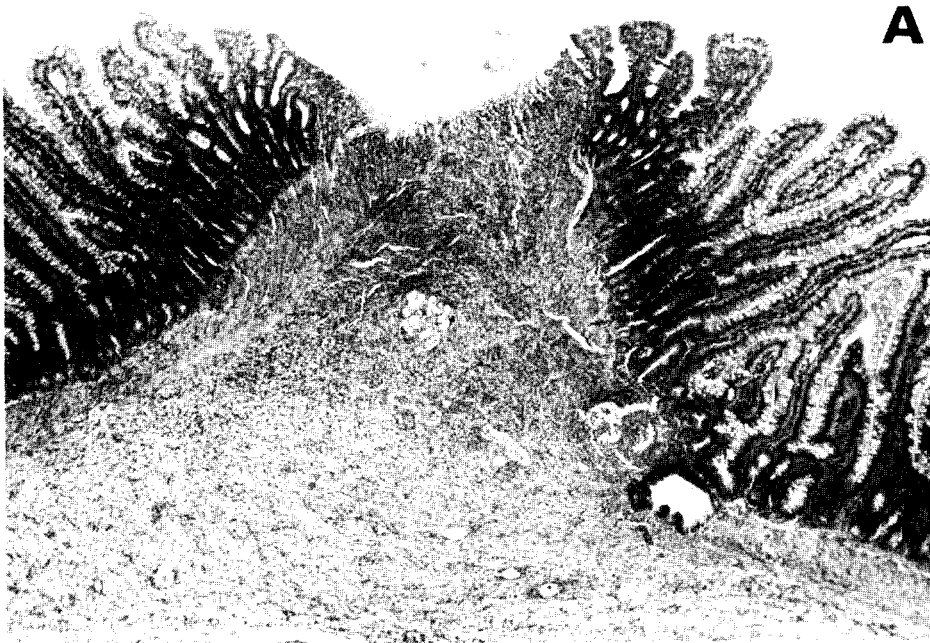


Fig. 3: Site of ileal anastomosis in rat with lymph stasis 7 days after bowel reconnection. Note delayed mucosal regeneration in A and reduced granulomatous reaction in B with few foreign body giant cells (arrow) and polymorphonuclear leukocytes. (A-25x; B-250x; H & E)

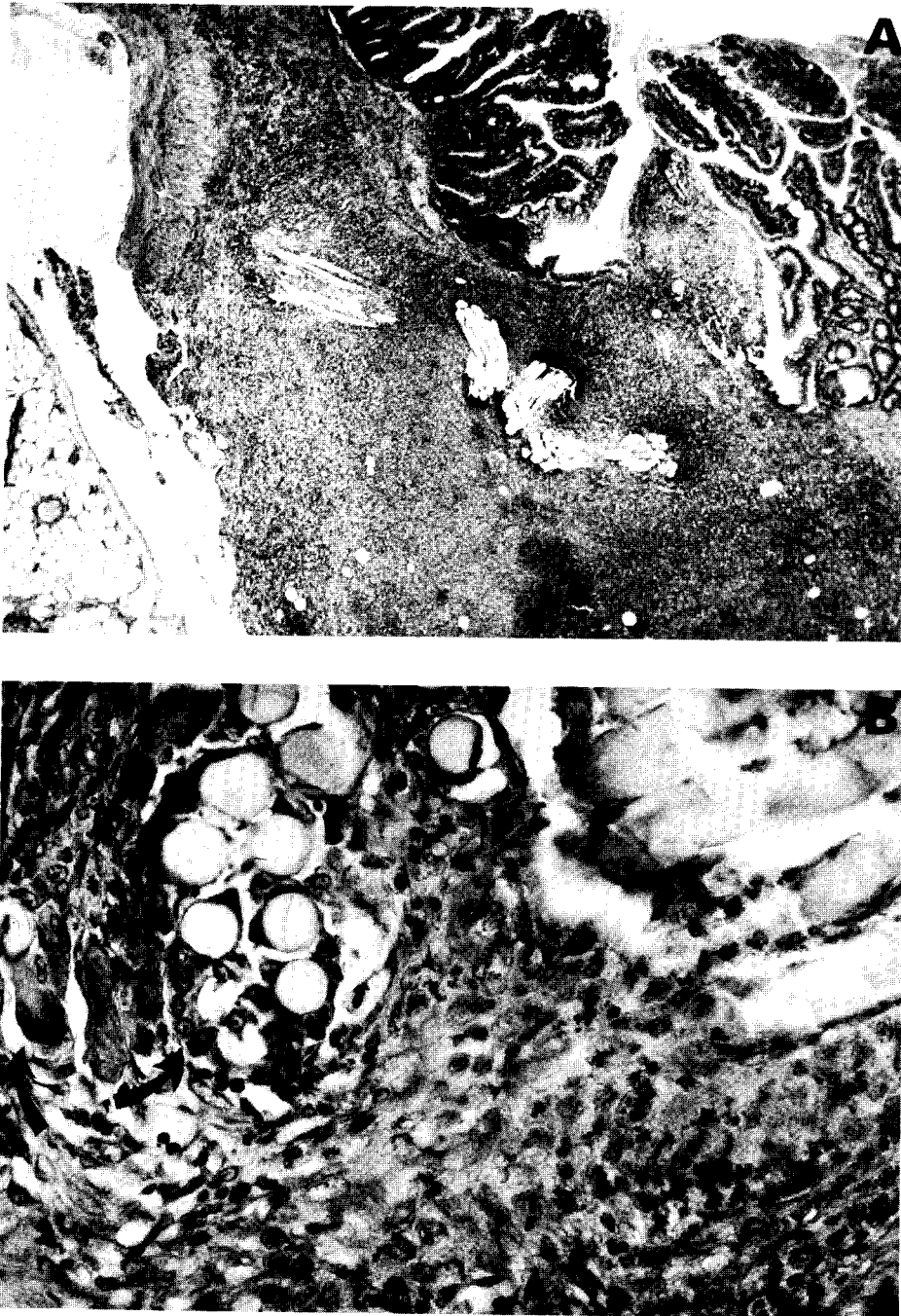


Fig. 4: Site of ileal anastomosis in rat without lymph stasis 7 days after bowel reconnection. Note near complete regeneration of mucosal layer (A) and more prominent granulomatous reaction (B) with foreign body giant cells having ingested the suture (arrow). (A-25x; B-250x; H & E)

stenosis, and local adhesions. A section of the ileum including the anastomosis was fixed in 10% buffered formalin and stained with hematoxylin and eosin. Histologic sections were roughly graded for small bowel dilatation, cellular infiltration and granulomatous reaction adjacent to the anastomosis.

RESULTS

In rats with lymph stasis (Group 1) 4 of 20 rats died during the first week, but none died in the sham-operated control (Group 2). Deaths were due to generalized peritonitis from anastomotic leakage. The ileum was edematous, and inextricably adherent by fibrous bands to nearby loops and the abdominal wall. By comparison in the sham-operated rats, anastomoses were mobile and free.

At 7 days, rats with lymph stasis showed marked dilatation of lymphatics and edema throughout the ileal wall (Fig. 1,2). There was also notable infiltration by polymorphonuclear leukocytes and monocytes in the ileal mucosa. On the other hand, granulomatous reaction was less prominent at 7 and 14 days as compared to sham-operated controls (Group 2) (Fig. 3,4).

At 14 days dilated lymphatics were still prominent in rats with lymph stasis and the submucosa and serosa adjacent to the anastomotic site remained more edematous. Although granuloma reaction was similar in the two groups at 14 days, it consisted primarily of pleomorphic foreign body giant cells in Group 1 whereas macrophages and histocytes dominated in Group 2.

DISCUSSION

Earlier studies revealed that mesenteric lymph stasis is associated with an increased thickness of the bowel from wall edema and cellular infiltration (13). Extending these observations, we demonstrated that an intestinal anastomosis in the presence of stagnant lymph induced more fibrous adhesions

and increased the likelihood of leakage with peritonitis and death. Moreover, the healing process of an ileal anastomosis was altered by lymphatic insufficiency. Exudative reaction persisted longer while histiocytic and fibroblastic repair was delayed.

These gross and microscopic findings suggest that optimum anastomotic healing in the rat small intestine requires an intact lymphatic system. With lymph stasis, healing is more disorganized and the risk of anastomotic leakage greater with resumption of peristalsis.

REFERENCES

1. Peacock, EE: Biologic frontiers in the control of healing. *Am. J. Surg.* 126 (1973), 709.
2. Ottaviani, G, J Casley-Smith, M Foldi: La linfologia una nuova entita clinica. *Medical Forum* 12 (1971), Zyma Nyam-Swiss.
3. Grassi, G, G D'Onofrio: Suture ed anastomosi intestinali. *Acts Soc. Ital. Chir.* 1 (1975), 733.
4. Peyton-Barnes, J: The techniques for end-to-end intestinal anastomosis. *Surg. Gynec. Obst.* 138 (1974), 433.
5. Laufman, H, T Rubel: Synthetic absorbable sutures. *Surg. Gynec. Obst.* 145 (1977), 597.
6. Matheson, NA, AD Irving: Single layer anastomosis in the intestinal tract. *Surg. Gynec. Obst.* 143 (1976), 619.
7. Jacobus, S: Crohn's disease of the appendix: Manifested as acute appendicitis with postoperative fistula. *Am. J. Gastroenterology* 71 (1979), 592.
8. Collan, Y, TV Kalina: The lymphatic pump of the intestinal villus of the rat. *Scand. J. Gastroent.* 5 (1970), 187.
9. Battistini, C, S De Franco, F Sandona, et al: Tecnica microchirurgica di anastomosi diretta linfangiovenosa nel ratto con ipertensione linfatica. *Il Policlinico Sez. Chir.* (1979), 807.
10. De Franco, S, M Gelmetti, L Lagasi, et al: Confronto tra anastomosi linfangiovenose ed adenolinfovenose nel ratto con linfostasi mesenterica. *L'Ateneo Parmense* 50 (1979), 69.
11. Eilert, JB, P Binder, PW McKinney, et al: Polyglycolic acid. Synthetic absorbable suture. *Am. J. Surg.* 121 (1971), 561.
12. Dardik, H, I Dardik, H Laufman: Clinical use of polyglycolic acid polymer as a new absorbable synthetic suture. *Am. J. Surg.* 121 (1971), 656.
13. Kalima, TV: The structure function of intestinal lymphatics and influence of impaired lymph flow on the ileum of rats. *Scand. J. Gastroenterology* 6, Suppl. 10 (1971), 1.