AE which Paterson et al(7) found effective in suppressing or preventing AE when passively administered to actively sensitized rats. Splenectomy might result in less production of this circulating factor and thereby permit LNC of a sensitized donor to be more efficacious in transfer.

It should be reemphasized here that the present, as well as our earlier(5), transfer studies in rats do not settle the question as to whether "sensitized" cells (delayed or tuberculin-type hypersensitivity) or conventional antibodies are directly responsible for initiating the damage recognized as AE. For it cannot be said as yet whether the lesions in recipients result from antibodies elaborated and shed by donor lymph node cells after their transfer or by interaction of the donor cells directly with antigen in the recipient's own nervous system. The simplified method of transferring AE in commercially available rats, described here, may help in answering this question.

Summary. Previously described methods of transferring allergic encephalomyelitis in commercially available randomly bred, albino rats sensitized to nervous tissue plus adjuvant, entailed use of parabiosis or pretreatment of recipients with normal spleen cells of prospective sensitized lymph node cell donors. Further study indicates that the disease may be transferred using lymph node cells of splenectomized donors sensitized to nervous tissue and either intact or splenectomized recipients. Splenectomy of only the recipient does not appear to facilitate transfer of the disease.

1. Paterson, P. Y., in *Cellular and Humoral Aspects of the Hypersensitive States*, edit. by H. S. Lawrence, P. B. Hoeber, New York, N. Y., 1959, p. 469.

2. Chase, M. W., in *Allergic Encephalomyelitis*, edit. by M. W. Kies, E. C. Alvord, Charles C. Thomas, Springfield, Ill., 1959, p. 348.

3. Paterson, P. Y., Harwin, S. M., Didakow, N. C., unpublished observation.

4. Lipton, M. M., Freund, J., *J. Immunol.*, 1953, v71, 380.

5. Paterson, P. Y., *J. Exp. Med.*, 1960, v111, 119.

6. Koprowski, H., Jervis, G. A., Schoeniger, D., *Fed. Proc.*, 1961, v20, 38 (Abst.).

7. Paterson, P. Y., Harwin, S. M., Didakow, N. C., *J. Clin. Invest.*, 1961, v40, 1069 (Abst.).

Received September 14, 1961 P.S.E.B.M., 1961, v108

Mann-Williamson Rat. (27062)

YASUO KUROYANAGI AND H. NECHELES*

Department of Gastrointestinal Research, Medical Research Institute of Michael Reese Hospital, Chicago, Ill.

The Mann-Williamson (M.W.) operation in the dog has been widely used in the study of experimental ulcer(1). We have succeeded in producing ulcer in the rat by a modified M.W. operation; the method and subsequent observations are reported here. We have used rats because they are cheaper than dogs and large numbers can be kept in relatively small space; also, the fact that anatomy and physiology of the stomach of the rat differ from that of the dog made the study desirable.

Methods. Fig. 1. Albino rats of Sprague-Dawley strain (both sexes) with initial weights between 172 g and 512 g (average 284 g) are fasted for 24 hours, water being given *ad lib.* The animal is etherized, and under clean but not aseptic precautions the abdomen is opened by a small incision in the upper midline; the pylorus is ligated and cut just proximal to the ligature. A 5-0 black silk thread is passed through the upper edge of the gastric stoma and secured with a small hemostat. The duodenum is pulled up; the bile duct with many pancreatic ducts entering it is seen coursing through the mesentery; it opens into the duodenum 2 to 3 cm below the pylorus. The jejunum is transected about 1

* Supported by U.S.P.H. grant A-2166.

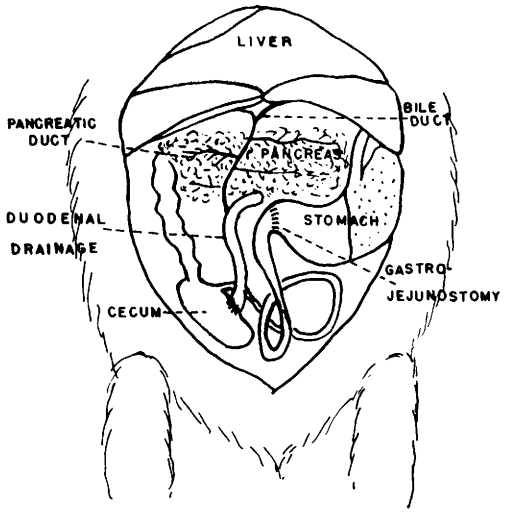

FIG. 1. Diagram of Mann-Williamson operation in the rat.

cm below the ligament of Treitz, and its caudal end is anastomosed end-to-end to the stomach with continuous suture, using the thread previously passed through the stomach; 10 stitches are adequate, serosal suture is not necessary. Next, the apex of the cecum is pulled up and incised 5 mm. The proximal end of the cut jejunum is anastomosed end-to-end to the incision in the cecum with continuous suture. No clamps are used, and usually little or no bleeding occurs. Five ml of 0.9% saline is injected into the peritoneal cavity before closure, and after operation Combiotic is given s.c.

Results. Table 1. Results are divided into 2 groups; A, animals that died or that were moribund and were killed after operation (4 to 11 days, average 7 days), and B, animals that survived longer (13 to 160 days, average 68 days). The reason for this division was the fact that in animals of group A most ulcers occurred in the prostomach, in group B most ulcers occurred at the gastrojejunal stoma and none were found in prostomach. Rats in Group A lost 33% body weight, an average of 13 g per day, and rats in Group B lost 48% body weight, an average 3.3 g per day. The incidence of ulcer was approximately equal in both groups (88% and 85% respectively). In Group A, 67% of ulcers were in prostomach, while in Group B, no ulcers were in prostomach and 87% were at the stoma. Most ulcers in glandular stomach, stoma, and jejunum were single, but in the case of the prostomach, most ulcers were multiple. Most ulcers were round, few were oval, and their size varied from 1 to 10 mm in length or diameter. The largest ulcers in both groups were found at the gastrojejunal stoma. Small erosions and punctuate hemorrhages, mainly in the glandular stomach, were seen in both groups. A number of ulcers in both groups had perforated. Fig. 2 shows multiple ulcers in prostomach of an animal of Group A. Fig. 3 shows a penetrating marginal ulcer in Group B, Fig. 4 shows section of deep marginal ulcer in Group B.

Discussion. The percentage of M.W. ulcers in the rat is approximately the same as in the dog(1). We have sought an explanation for the different distribution of ulcers in Groups A and B namely, the prevalence of ulcers in the prostomach in the early death Group A and of ulcers at the stoma in the late death Group B. The rats in Group A lost approximately 13 g of body weight per day within a short period of time, while the rats in Group B lost only 3.3 g per day over a longer period of time. In Group A, obstruction at the gastrojejunostomy was noted in some of the animals, apparently due to edema and fibrous contraction at the suture line. It is possible that edema may have been present in more animals of that group, and that it disappeared by time of autopsy. If this were the case, increased intragastric pressure and gastric distention would have contributed to formation of ulcers in the forestomach, as we have de-

TABLE I. Occurrence of Ulcers.

Group	No. of Rats	Avg Survival Days	No. of Rats with No ulcer	Ulcer	No. of ulcers Prostomach	Gland.Stom.	Stoma	Jejun.
A	17	7	2	15	10	3	5*	0
B	27	68	4	23	0	1†	20	8‡

* also 3 ulcers in prostomach. † also ulcer in stomach and jejunum. ‡ also 5 ulcers in stoma.

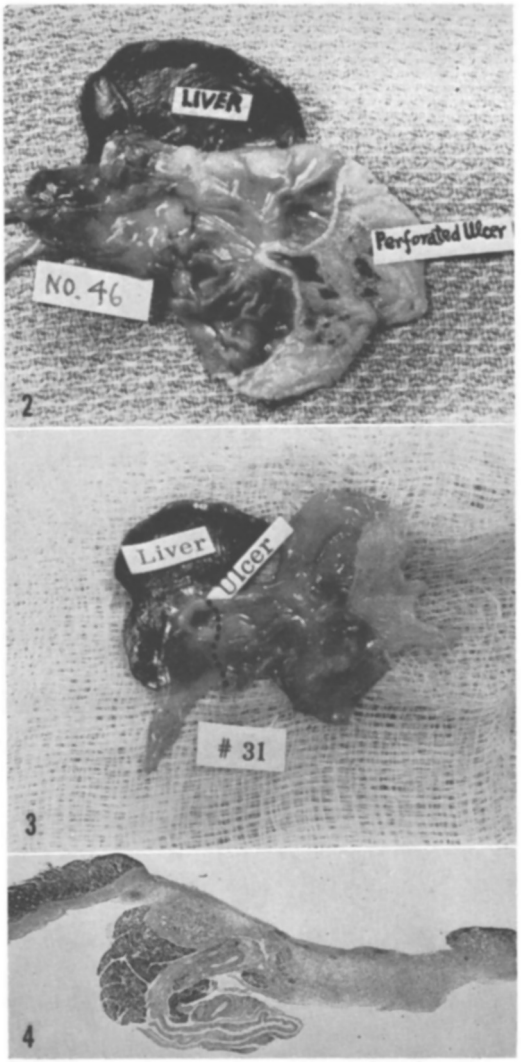

FIG. 2. Early death group (A). Stomach of rat with multiple ulcers in prostomach, one of them perforated. Large ulcer at cardia. Died 7 days after operation.

FIG. 3. Late death group (B). Stomach of rat with one large ulcer at suture line, penetrating into liver. Suture line indicated by dots. Died 107 days after operation.

FIG. 4. Late death group (B). Section through ulcer of stomach of rat with 1 large ulcer at suture line. Floor of ulcer contains dense fibrous tissue with eosinophilic stain. Died 66 days after operation.

scribed in the pylorus ligated mouse(2).

In Group B, most ulcers appeared at the stoma. We are inclined to believe that these ulcers are caused by a deficient blood supply to the region of the anastomosis. Berg(3) has pointed out the relative paucity of arteries in the stomach of the rat, and the lack of adequate collaterals. Injected specimen of rats' stomachs supports our assumption that marginal ulcer in the M. W. rat may well be due to circulatory deficiency(4). Thus it may be possible that marginal (anastomotic) ulcer is caused as much or more by inadequate blood supply than by acid-pepsin, an idea which we have suggested earlier(2,5-7). In both groups, but particularly in Group A, starvation, loss of weight, and malnutrition, may have contributed to the production of peptic ulcer. Anastomotic ulcers were larger and appeared to be older than jejunal ulcers.

We believe that the results of Group B, the animals with prolonged survival time and with a high incidence of ulcers at stoma and jejunum, represent the typical pathology of the M.W. rat.

Summary. The Mann-Williamson operation has been applied to the rat; gastric, marginal, and jejunal ulcers were seen in 85% of the animals. Early postoperative deaths may have been due to obstruction at the gastro-jejunal anastomosis; these animals developed a high incidence of ulcers in the prostomach. In rats that lived longer, the majority of ulcers were found at or nearby the gastro-jejunal anastomosis. It is felt that this latter group is representative of typical Mann-Williamson ulcer in the rat. A possible role of vascular factors in the production of ulcer is discussed.

1. Mann, F. C., Williamson, C. S., *Ann. Surg.*, 1923, v17, 409.

2. McArthur, Wm., Michel, A., *Am. J. Physiol*, 1960, v198, 737.

3. Berg, B. N., *Arch. Surg.*, 1947, v54, 58.

4. Kuroyanagi, Y., Chiles, Th., Necheles, H., in preparation.

5. Necheles, H., Gordon, M. R., Gaspar, H., Walker, L., *Am. J. Physiol.*, 1957, v190, 252.

6. McArthur, Wm., Ogawa, T., Necheles, H., *ibid.*, 1959, v196, 979.

7. Ogawa, T., Necheles, H., *J. Appl. Physiol.*, 1959, v14, 861.

Received September 18, 1961 P.S.E.B.M., 1961, v108