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Comparative Study of the Penrose Drain and Drains of Teflon.* (20896)

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It has been recognized that a drain that would drain longer and more freely, and which would cause less adhesion formation due to the irritant properties of the drain itself would be desirable. In this respect it was decided to compare a commonly used rubber sheathed gauze filled drain, the Penrose drain (commonly called cigarette drain), with drains made of a new non-reactive plastic, Teflon. Studies to determine the reactivity of Teflon in the peritoneal cavity of the rat were done and confirmed the conclusions reached by LaVeen and Barberio(1) in their work on the dog, that Teflon elicited minimal or no tissue reaction. This absence of tissue reaction seemed to warrant a trial of drains made of this substance.

Materials and methods. Four types of drains were studied: 1) a rubber Penrose drain with a gauze filler, 2) a drain of Teflon with a gauze filler, 3) a drain of Teflon with a Teflon filler, and 4) a drain of Teflon that differed in shape by being folded several times so as to present a fluted appearance, as compared to the tubular form of the other drains. Teflon tubing was not available in the form desired to make the tubular drains so Teflon sheet .003 inch in thickness was obtained and the drains made from this. The edges were sewn with a thin strip of Teflon and inverted so

that the outer surface of the drain presented as uniform a surface as possible. The gauze fillers in the Penrose drain and in the Teflon drain were identical. The filler of Teflon for the one type of drain was made by fluting 2 pieces of Teflon, each 1 inch wide and then this was fitted into the drain. The fluted drain of Teflon was made by folding a one inch wide piece of the sheet four times with the folds parallel to the long axis. All of the drains were one-and-a-half inches long and the tubular drains were 5/16 inch in diameter. The drains were prepared for operation by being washed in ethyl alcohol and rinsed in distilled water. Then the appropriate fillers were inserted in those drains using them and all of the drains autoclaved. The *operative procedure* to install the drain was done under ether anesthesia. The abdomen of the rat was shaved and then prepared by swabbing with tincture of iodine and removing the excess with 95% ethyl alcohol. Sterile technic was followed with the exception that gloves were not worn. A mid-line ventral incision was made in the upper half of the abdomen and the peritoneal cavity opened. The drains were then placed through a stab-wound made on the right side of the animal. Following this the peritoneum with overlying muscle was closed with a continuous suture of black silk. The drain was secured in place with a stitch of black silk passing twice through the skin and the drain. The skin was closed with a

* The Teflon was supplied by the Polymer Corp. of Pennsylvania.

TABLE I.

Group	Type of drain	No. of rats	Rats draining		Rats c adhesions	
			No.	%	No.	%
12 hr	P*	12	12	100	9	75
18	"	6	3	50	6	100
	Tg	3	3	100	1	33.3
	Tt	3	3	100	0	0
	Ft	6	6	100	0	0
24	P	6	1	16.6	6	100
	Tg	3	3	100	1	33.3
	Tt	3	3	100	0	0
	Ft	6	6	100	0	0
36	P	6	0	0	6	100
	Tg	3	3	100	0	0
	Tt	3	3	100	0	0
	Ft	6	6	100	0	0
48	P	6	1	16.6	6	100
	Tg	3	2	66.6	2	66.6
	Tt	3	3	100	0	0
	Ft	6	6	100	0	0
3 day	P	6	1	16.6	6	100
	Ft	6	6	100	0	0
5	P	6	3	50	5	83.3
	Ft	6	5	83.3	2	33.3
7	P	6	1	16.6	6	100
	Ft	6	2	33.3	4	66.6

* P = Penrose; Tg = Teflon-gauze; Tt = Teflon-teflon; Ft = Fluted-teflon.

continuous suture of black silk. The drain site was dressed by placing a piece of adhesive tape with a hole cut from the center so that the end of the drain protruded from the opening; this was then covered with a piece of gauze that was secured with more adhesive tape. It was found necessary to dress the animals this way so that they would not remove the drains. A total of 120 animals was studied in two separate groups.

The drainage qualities of the various drains were tested by injecting 5 cc of an aqueous solution of Methylene Blue intraperitoneally at a site distant from the drain and then noting the appearance of the dye at the drain site. Approximately 15-30 minutes after the injection of the dye the animals were autopsied. This was done to observe the causation of any blockage and to note the presence of adhesions to the drain and the drainage site. The criteria of drainage was the appearance of any dye, no matter how slight, at the drainage site. The criteria for adhesion formation was the presence of any adhesion af-

fixed to the drain or any abdominal viscus that did not readily slide off the drain incident to the process of folding back the flap of abdominal wall to view the interior.

Results. A table combining all of the data resulting from this experiment may be seen in Table I. Some aspects of the results not presentable in table form should be mentioned: 1) all of the adhesions to the Penrose drains in the 12 hour group were quite fragile and consisted of the omentum alone being wrapped about the drain. 2) In all cases of adhesions to and blockage of a Teflon drain with a gauze filler the adhesions were to the gauze, not the Teflon. 3) The drainage observed with the Teflon drains with Teflon fillers and the Fluted-Teflon drains was in all instances immediate and profuse whereas in those instances of drainage from the Penrose drains the drainage was slight in amount and usually occurred several minutes after the injection of the dye. 4) The Fluted-Teflon drains that showed no drainage and adhesions at the 5 and 7 day intervals had gross infection of the wound site with the rest of the abdomen clear while the animals that showed drainage revealed no indication of infection.

The results of the experiment lead to the conclusion that drains of a non-reactive substance remain functional considerably longer than those of a substance such as the rubber found in the Penrose drains which evokes a peritoneal reaction. Adhesion formation due to the irritant composition of the drain itself is also less likely to occur. It is interesting to note that those drains of Teflon with the gauze fillers sometimes became blocked to some extent by the omentum and bowel adhering to the gauze at the end of the drain, but never to the Teflon. The Fluted-Teflon drain that was used, in general showed the most drainage, although this experiment was not designed to measure accurately the amount of drainage that occurred with the various types, but rather was designed to be qualitative in nature and to show only whether or not drainage occurred from the peritoneal cavity. It can be concluded that the Fluted-Teflon drain and the drain made of Teflon with a Teflon filler showed desirable properties. The

good results from drains of this sort, as studied in the rat, warrant further study in either larger animals or on the clinical level.

Summary. Drains made of Teflon show that, in the rat, drainage from the peritoneal cavity continued through them significantly longer than through Penrose drains. It has also

been shown that there were fewer adhesions secondary to the use of this type of drain than with the Penrose drains.

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Quantitative Aspects of Micro ATPase Measurements on Plasma from Chicks with Erythromyeloblastic Leukosis.* (20897)

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We(1) described a rapid micro test for estimation of the enzymatic activity of the plasmas of chicks with erythromyeloblastic leukosis to dephosphorylate adenosine triphosphate. The procedure was invaluable in the selection of plasmas of high enzymatic activity, and, consequently, of high virus content(2-4), but the results formerly observed were variable. Further studies directed changes in the micro test with resulting decrease in apparent variation and great increase in sensitivity. The vital utility of the procedure in studies of leukosis virus would appear to warrant the present report of the simple changes in the test.

Materials and methods. Procedures were identical with those already described(1) except for the volume of plasma and the constitution of the indicator solution. For the latter, there was prepared, first, a saline solution containing, in final concentration: KCl, 0.05 M; NaCl, 0.05 M; CaCl₂, 0.04 M; and MgCl₂, 0.04 M. To this solution there were added 10 ml of brom thymol blue (0.04%, Hartman-Leddon Co., Philadelphia, Pa.). Finally, 150 mg of the dipotassium (or disodium) salt of adenosine triphosphate were dissolved in the

solution, and the pH adjusted to 8.2. The solution was brought to a final volume of 50 ml and parcelled in 2.5 ml volumes in tightly stoppered tubes, at -18°C. A precipitate is formed when the pH is adjusted, but it does not interfere with the reaction. However, it should be kept dispersed during all sampling of the preparation. The indicator solution remained useful for a month or more, but new preparations were made at about 2-week intervals. Residues of the solution once thawed were discarded after the day's work. The volume of plasma employed was 3 λ , which was deposited at the bottom of a long narrow tube as before(1), and 0.12 ml of the indicator solution added. From this point the procedures were the same as those previously described(1). Precision of the micro test was estimated by electrotitrimetric measurement of the liberation of acid with larger volumes of the same plasmas. This method was essentially like that described earlier(1) with the following changes: the ionic constitution of the reaction medium, in a total volume of 25 ml, was the same as that used in the present micro test, and the pH index point was 7 instead of 8. In addition, the solution of adenosine triphosphate, of which 1 ml was used to initiate the reaction, contained 6 mg of the salt/ml, together with the same salts in the same concentrations used in the reaction medium prior to the introduction of the ATP.

Results. The findings are illustrated in Fig. 1a and 1b. The liberation of phosphorus by

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