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An Experimental Study with Tantalum.

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Venable, Stuck and Beach[1] introduced vitallium into surgery. This metal is an alloy of cobalt, chromium and molybdenum. While widely used and excellently tolerated by tissue, it has certain metallurgical disadvantages. It cannot be drawn into wire and cannot be worked in the cold state. This necessitates casting. For these reasons, a survey of other metals was undertaken, and on account of its properties, the element tantalum was selected. Its atomic weight is 181.4; atomic number 73. The metal is characterized by a marked resistance to chemical corrosion, being attacked only by hydrofluoric acid and concentrated alkalis. It is ductile and malleable in the cold state. Due to these properties, it seemed ideal for certain surgical procedures.

Samples were obtained from the manufacturer,* and after a few preliminary experiments it was used clinically. These early experiences were so satisfactory that its use has been continued. Publications of the results, however, have been withheld until further clinical and experimental evidence was obtained. Burke[2] reported on 34 clinical cases in which it was used as a suture material. Recently, Pudenz[3] has found the metal of great advantage in neurosurgery. Our clinical data will be reported elsewhere. The purpose of this communication is to report certain observations on the reaction of the tissues of dogs to tantalum.

Method. Tantalum plates and screws were weighed and aseptically applied to the tibia

TABLE I.

Dog No.	Site	Material	Initial wt	Duration, days	Wt at removal	Loss
2	Tibia	Tantalum Plate	6.1450	180	6.1360	.0090
	,,	,, Screw	1.2971	180	1.2950	.0021
	,,	,, ,,	1.3420	180	1.3400	.0050
3	,,	,, Plate	6.0750	150	6.0735	.0015
	,,	,, Screw	1.3160	150	1.3160	.0000
	,,	,, ,,	1.3100	150	1.3090	.0010
27	,,	,, ,,	1.6890	35	1.6880	.0010
	,,	,, ,,	2.0015	35	2.0013	.0002
30	,,	,, ,,	1.3394	33	1.3394	.0000
	,,	,, ,,	1.2947	33	1.2946	.0001
28	,,	Iron ,,	.5494	32	.5430	.0064
	,,	,, ,,	.5558	32	.5505	.0053
29	,,	Brass ,,	.5495	30	.5370	.0125
	,,	,, ,,	.5622	30	.5475	.0147
22	Abd. Wall	Tantalum Plate	6.1789	22	6.1778	.0011
23	,, ,,	,, ,,	6.6210	24	6.6195	.0015
24	,, ,,	Iron ,,	3.5950	20	3.6024	.0074*
25	,, ,,	Brass ,,	4.9290	20	4.9176	.0114
26	,, ,,	Galv. Tin ,,	3.9540	20	3.9739	.0199*

*Gain.

1 Venable, C., Stuck, W., and Beach, A., *Trans. South. Surg. Assn.*, 1936, **49**, 294.

* Fansteel Metallurgical Corporation, North Chicago, Illinois.

2 Burke, G. L., *Canad. Med. Assn. J.*, 1940, **43**, 125.

3 Pudenz, R. H., unpublished data.

of dogs and were allowed to remain from 30 to 108 days. In addition, tantalum plates were buried in the abdominal wall of dogs. For comparative purposes a limited number of screws and plates of iron, galvanized tin and brass were used. At the termination of the experiment the animals were X-rayed and the metallic implants removed and weighed. The condition of the surrounding tissues was carefully noted and specimens removed for microscopic study.

X-ray Observations. The density of the bone adjacent to the tantalum plates was increased. There was also an increase in density along the shafts of the screws. In the animals with iron and brass screws there was a decrease in density and rarefaction as early as 30 to 32 days.

Weight Changes. These changes are shown in the accompanying table.

Gross Appearance of the Tissue. Surrounding the tantalum there was a thin film of shiny fibrous tissue. In no instancce was discoloration present. Beyond the film the tissues appeared normal. The periosteum of the bone adjacent to the tantalum plates was thickened. Around the iron there was a definite, but slight brownish discoloration. Brass produced a greenish discoloration and marked edema.

Microscopic Appearance of Tissue. The thin film of shiny tissue surrounding the tantalum plates was seen to be composed of fibroblasts. No edema and no inflammatory changes were noted. Sections of the decalcified bone showed no change in the bone substance and a small fibrous capsule adjacent to the periosteum. Sections of tissue exposed to other metals exhibit varying degrees of tissue reaction to the foreign body. Galvanized tin showed a large deposit on the plate, but only small amount of increase in the fibrous tissue about the plate. Brass showed an extreme tissue reaction with edema, fibrin deposit and cellular infiltration. Sections of tissue surrounding brass and iron show large amounts of metallic deposits.

Conclusions. Tantalum implanted in soft tissues is encapsulated by a thin layer of fibrous tissue. On the surface of the bone a similar reaction is observed, and in addition, X-ray reveals an increased density in the underlying bone. The metal is apparently well tolerated by tissue.

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A Microtome Sectioning Technique for Electron Microscopy Illustrated with Sections of Striated Muscle.

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The preparation of histological and cytological sections for study with the electron microscope presents several difficulties. These are due chiefly to the necessity of drying and to the low penetrating power of electrons.[1] The distortion commonly attendant on air-drying can be obviated by vacuum-drying in the frozen state. The low penetrating power of electrons is more serious since for high resolution electron micrographs it has been found that sections must be less than 0.25 μ and preferably less than 0.1 μ thick.[2] von Ardenne[3] has described a method, but, judging from the one micrograph published, his sections were not sufficiently thin for good resolution or adequate penetration. The present paper describes a technique by means

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1 See any recent article on electron microscopy.

2 Richards, A. G., Jr., and Anderson, T. F., *J. Morph.*, 1942, **71**, in press.

3 *Z. wiss. Mikr. u. mikr. Tech.*, 1940, **57**, 291.