EXPERIMENTAL ANEURYSMS*

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WITH IMPROVED surgical methods for the direct treatment of arterial aneurysms—by excision, grafting, bypassing and wrapping, the need has arisen for more extensive study of these problems in the experimental laboratory. This work has been hampered, however, by the lack of a satisfactory method for the production of aneurysms in experimental animals. Halsted[1] was able to cause dilatation of the terminal branches of dogs' aortas by partial metal band occlusion of the aorta, but reported that these aneurysms could not be produced with consistency. Klatz[2] demonstrated that atheromatous degeneration developed in the aortas of dogs maintained on a high cholesteral diet following thyroidectomy. Holman and Swanton[3] produced necrotizing arteritis in dogs by the administration of a high lipid diet. Such lesions are fairly typical of atherosclerosis and of the medial degeneration preceding dissecting aneurysms, but lack the wall destruction and dilatation characteristic of clinical aneurysms.

In attempting to find a suitable material for the wrapping and strengthening of the walls of large aneurysms, inoperable by other means, we have encountered a method for the production of aneurysms in experimental animals which has been useful in this laboratory, and may therefore prove of some value to others interested in this field. Hill,[4] in performing necropsies upon patients who have been treated by intra-arterial nitrogen mustard for advanced malignancy, observed that small aneurysms are sometimes found at the site of injection of the mustard. Following this suggestion, solutions of nitrogen mustard of varying strengths were injected into the walls of dogs' aortas. It was found that destruction of the media resulted in aneurysmal dilatation of the vessel wall, leading to rupture of the aorta within four to 28 days, depending upon the concentration of the necrotizing agent.

Technique. A 5 cm. segment of the descending aorta of a dog is isolated, freed from pleura, and its intercostal branches (three or four in number) ligated and divided. Five cubic centimeters of sterile saline solution containing from 2.5 mg. to 10 mg. of nitrogen mustard is injected just under the adventitia to raise a blister which almost completely surrounds the aorta over a length of 2 cm. to 3 cm. Care is taken to avoid spilling any of the solution into the chest. The injected segment is wrapped in a sheet of nonsclerosing polythene to protect the surrounding structures and the chest is closed.

To produce a dissecting aneurysm, the same technic is employed as above; in addition, however, some of the solution is injected through the intima at one point to provide a channel for the dissection of blood.

DISCUSSION

The injection of 10 mg. of nitrogen mustard by this method resulted in destruction of the media, with dilatation of the aorta (Figs. 1, 2 and 3). In most instances rupture occurred in from four to 14 days. When

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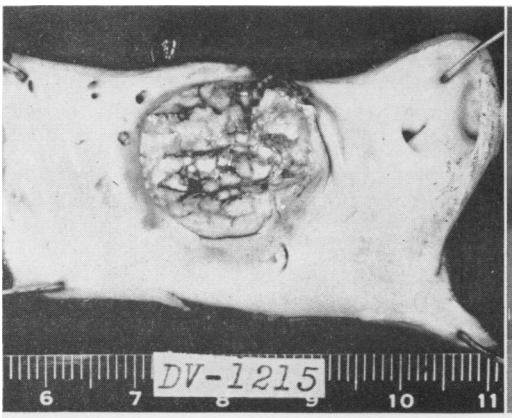


FIG. 1

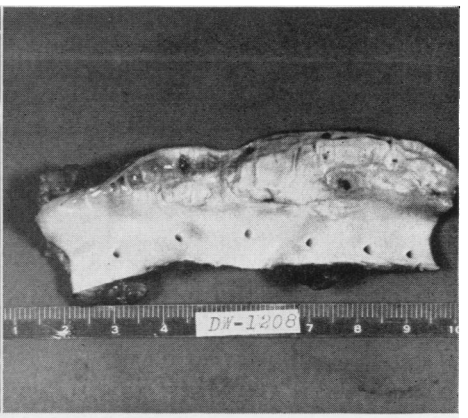
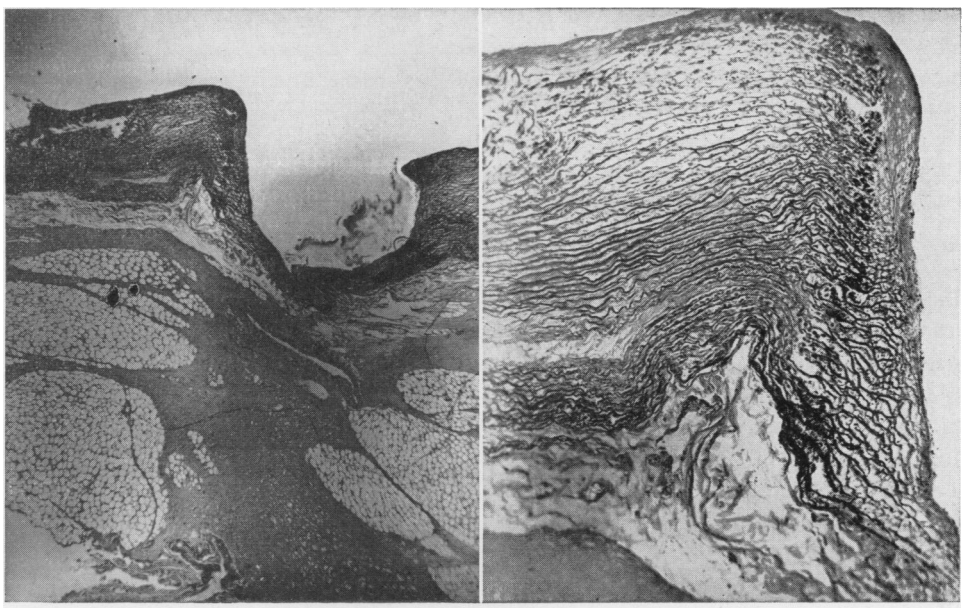


FIG. 2

FIG. 1. Aneurysm produced by injection of 10 mg. of nitrogen mustard into the wall of a dog's aorta. Animal died 14 days later from renal failure due to aortic thrombosis.

FIG. 2. Aneurysm resulting from injection of 5 mg. of nitrogen mustard into a dog's aortic wall twice at four day intervals. Animal died of distemper 12 days after injection.



A B

FIG. 3, A and B. Destruction of media with dilatation of aortic wall resulting from the intramural injection of 5 mg. of nitrogen mustard.

2.5 mg. to 5 mg. of the sclerosing agent was injected, medial necrosis and rupture usually occurred in from 10 to 14 days (Fig. 4). Dissecting aneurysms produced by injecting the solution into the intima as well as the media ruptured at a time inversely proportional to the concentration of the sclerosing agent (Fig. 5). No complications were observed in the animals except for one instance of thrombosis of the aorta and one of intracardiac, mural thrombosis. Care must be exercised to avoid injury to the thoracic duct which lies directly posterior to the lower descending thoracic aorta in dogs.

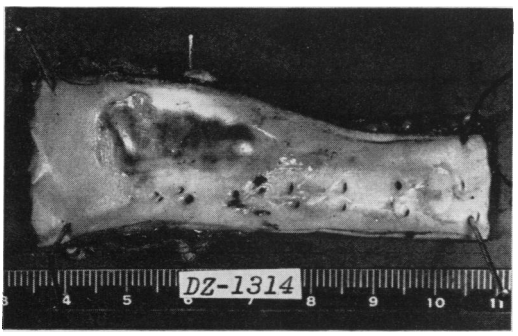


FIG. 4. Aneurysm following injection of 3 mg. of nitrogen mustard into a dog's aortic wall. Animal died of distemper four weeks later.

clinical aneurysms. The principle disadvantage of the method has been the fact that the degree of dilatation in most instances is not great, since rupture occurs early. This may be overcome by employing less concentrated solutions of the necrotizing agent.

SUMMARY

A method has been described for the production of aneurysms in experimental animals by the injection of nitrogen mustard into the artery wall. Advantages and disadvantages of the procedure have been discussed.

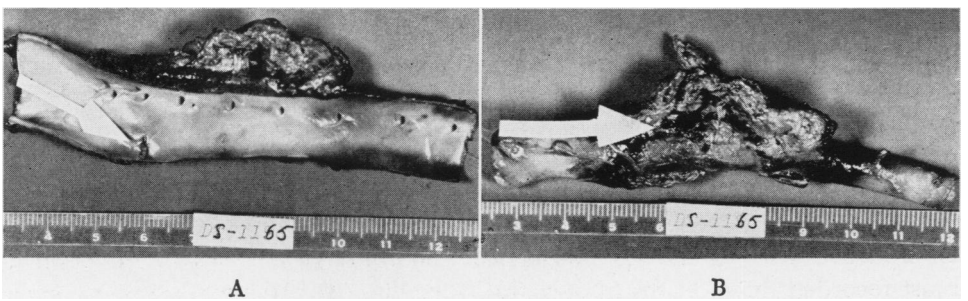


FIG. 5. A. Dissecting aneurysm produced by the injection of 10 mg. of nitrogen mustard into a dog's aortic wall and, at one point (shown by arrow), through the intima. B. Same, with area of dissection opened.

This method of aneurysm formation has several advantages. The lesions are produced easily within a short period of time. They form with constancy and rupture consistently so that an end point is provided for experimental procedures aimed at their prevention or treatment. They are probably more difficult to treat successfully than most clinical lesions, and therefore any method of wrapping or direct surgical intervention which prevents their rupture and allows them to heal should also be successful in

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