histidine(7). From this it could be argued that cobalt inhibits virus growth by depriving the virus of histidine, an essential nutrient. However, cysteine which has not been shown to be a constituent of influenza virus and sodium thioglycolate which should be inert nutritionally also counteract the virustatic action of cobalt. Both the imidazole group of histidine and the sulfhydryl (–SH) group of cysteine or thioglycollic acid with which cobaltous ions chelate are also important chemically active groups in larger protein and nucleic acid molecules. Recent work by Burney and Golub(8) has suggested that –SH groups are present in the elementary bodies of psittacosis. These authors have demonstrated that p-chloromercuribenzoic acid completely inactivates psittacosis virus and that glutathione or cysteine reactivates the virus. In analogous experiments Klein *et al.*(9) have restored influenza virus activity with BAL and thioglycolate following inactivation by mercuric chloride. The influenza virus-cobalt-cysteine and virus-cobalt-thioglycolate relationships described above may involve –SH groups as well as imidazole groups in compounds necessary for viral growth. The compounds might be constituents of the virus particle or cellular enzymes of the host. With a sufficient excess of either the –SH bearing compounds, cysteine and thioglycolate or of histidine with its imidazole group, cobaltous ions would be removed from complexes previously formed through both types of linkage; *i.e.* chelation between cobaltous ions and imidazole groups or between cobaltous ions and sulfhydryl groups.

Summary. The growth of the virus of influenza in embryonated eggs is inhibited by cobaltous ion. This inhibition is overcome by the subsequent addition of histidine, cysteine and sodium thioglycolate.

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Indwelling Pulmonary Arterial and Venous Catheters in the Dog.* (19836)

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In order to obtain pressure measurements or blood samples from the pulmonary vessels of unanesthetized animals over a long period of time, investigators have usually resorted to externalizing the blood vessels to the chest wall by various types of cannulas. This requires major surgery. The following method describes a relatively simple procedure for placing and securing polyethylene tubes in the pulmonary artery or vein without resort to major surgery. They are introduced through the external jugular vein and common carotid artery, respectively. Catheters in the pulmonary artery have been retained in dogs up to two months. Such animals seem to keep in perfect health.

Placing the catheter into the pulmonary artery. Polyethelene tubes having an inside diameter of 1.27 mm (Clay-Adams cat. No.

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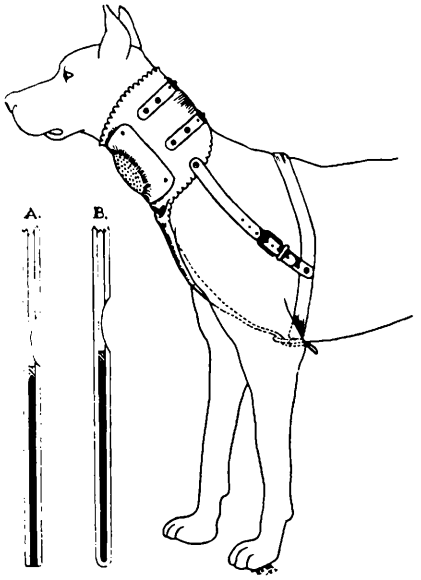

FIG. 1. A collar designed to protect the free ends of the indwelling tubes leading to the pulmonary artery and vein. A perforated metal plate bulges outward over the area of the incision. For fluoroscopic visualization the polyethelene tips were provided either with a nail (A) or mercury (B). (See text.)

PE 90) were cut to 100 cm lengths. In order to visualize the tip under the fluoroscope, our original method was to push a small, tight fitting nail into the end of the tube, after first removing its point and head. The metal piece was then sealed in place with glyptal and a smooth edged hole cut in the tube just behind the nail. More recently we have sealed off one end by heat and filled the tube with mercury for a distance of about two centimeters. A small hole is cut just above the level of the mercury which is sealed in place with glyptal. This latter method has the advantage of supplying a flexible catheter tip which is less likely to cause tissue damage. Longitudinal sections of each type of catheter tip are shown in Fig. 1.

The dogs were anesthetized with nembutal, and their necks shaved and cleaned. A section of jugular vein was exposed through a small incision, tied off distally, and the tube inserted through a small cut in the vein. A slow saline drip was started. With the dog lying on its side, the catheter tip was visualized under the fluoroscope and advanced into the right ventricle. In order to move the tip beyond this point, it was necessary to remove the saline drip and insert a stiff, flexible wire to within about 2 cm of the opening. With this extra support the tip of the catheter could now be moved along the inside curvature of the ventricle towards the pulmonary artery. This was most readily accomplished by advancing the tube a few centimeters, withdrawing the wire a few centimeters, advancing the tube, etc., until the tip was headed towards the artery. The wire was then withdrawn and the tip brought to the desired position in the artery, usually the diaphragmatic branch. After the saline drip had been started again, the loose ends of a tight ligature securing the catheter to the vein were sewn through the skin and tied. In order to permit drainage, no other stitching was done. The tube was then filled with heparin solution (50 mg/ml), and plugged, folded in loops, and taped to the neck with thin strips of adhesive tape. 600000 units of procain-penicillin were injected intramuscularly. A collar was designed to protect the free end of the catheter and yet allow free access of air to the incision. It consists of a wide piece of leather which covers the whole neck. A section of perforated sheet metal bulges outward over the area of the incision, allowing air to reach the wound. The collar is fastened with buckles and straps. To prevent twisting of the collar, a leather strap is fastened around the body just behind the forelegs and three straps connect it to the collar, 2 near the shoulder and one between the legs. The collar, as it appears on the dog, is illustrated in Fig. 1.

Placement of catheter into the pulmonary vein. The polyethelene tubes were prepared similar to those described above except that they are about 200 cm in length. A section of the common carotid artery was exposed through a small incision and tied off distally. A No. 10 radio-opaque cardiac catheter was inserted into the artery with a pressurized saline drip. After the catheter had been advanced in a retrograde manner into the low pressure system of the pulmonary vein, the saline drip was discontinued and the polyethelene tube threaded through the catheter until its tip was visible under the fluoroscope. By careful manipulation the regular cardiac

catheter could be withdrawn leaving the polyethelene tube in place. Two fine wire ligatures were tied around the carotid artery to secure the tubing and stitched through either side of the incision in such a way as to externalize the cut end of the artery.

Results. Wound healing was found to occur within about 10 days provided penicillin was infiltrated in the incision during the operation. Seven dogs were prepared with indwelling catheters in the pulmonary artery and lived in apparent health and good spirits. Three of these animals retained these tubes for 41, 50 and 56 days, respectively. No clotting occurred in the tubes provided the heparin was changed at least once or twice a week. Blood samples could be withdrawn at any time and the pressures measured. At various times after successful healing in of the pulmonary arterial tubes, the catheterizations of the pulmonary veins were made. Contrary to the successful results on the pulmonary arterial side apparently considerable trauma is caused by the pulmonary venous catheters. In spite of all possible therapeutic measures wound healing was slow. The dogs lost their spirit and usually succumbed within 10 days unless the catheter was withdrawn. Autopsies revealed interlacing antemortem clots, raised hard plaques lining the vessel walls and inflammation of heart valves. The evidence strongly indicates that death was a consequence of the placing of the pulmonary venous catheter.

Summary. A method is described for placing permanent polyethelene catheters into the pulmonary artery and vein of dogs through the jugular vein and common carotid artery, respectively. The pulmonary artery catheter seems to cause little trouble to the animals and has been kept in place up to 56 days for sampling blood and measuring pressures. The pulmonary vein catheters, however, cause considerable trauma and animals succumb within 10 days after placement of the tube.

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Further Investigation of Effect of Colloidal Materials upon the Shwartzman Phenomenon.* (19837)

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When the Shwartzman phenomenon is elicited at two-day intervals in rabbits, successive skin lesions rapidly diminish in intensity and animals soon become completely non-reactive (1,2). The production of hemorrhagic skin lesions is not necessary for the development of resistance, repeated parenteral administration of bacterial materials being effective in inducing the state of non-reactivity(2,3). This type of acquired resistance to the Shwartzman reaction resembles closely the tolerance to the pyrogenic action of bacterial endotoxins which develops in the course of repeated injections of these materials in animals or humans(4), one similarity being that both types of resistance are abolished promptly by injection of thorotrast or trypan blue(1,5). This has been interpreted as indicating a role of the fixed phagocytes of the "reticulo-endothelial system" in the removal of bacterial toxins from the blood stream(1).

In the original studies of Beeson on the Shwartzman phenomenon, thorotrast was administered 16 hours before the intravenous provocative injection of bacterial toxin(1). The present report describes experiments designed to determine the effect of giving thorotrast at varying times before the provocative injection in resistant animals as well as observations on the effect of administration of a colloidal iodide preparation upon non-reactivity to the Shwartzman reaction.

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