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A Standard Method of Producing Shock in Dogs by a Single Massive Hemorrhage.*

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The problem of producing consistently fatal shock in dogs by a single massive bleeding is complicated by the great variability in the tolerance of these animals to hemorrhage. If bled a fixed volume per unit of body weight, the results are inconstant due to the wide range in the blood volume/body weight ratio in this species. Removal of a fixed percentage of the measured blood volume is likewise unreliable because of the variability in the magnitude of compensatory replacement of both plasma and cells (*i.e.*, with tissue fluid and splenic reserve). Dogs subjected to a single massive hemorrhage by either method may compensate sufficiently to restore the blood volume above the critical level where progressive shock develops or they may fail to compensate and die immediately. The problem is to bleed in such a way that the outcome will be fatal after a period of time sufficiently long to produce the characteristic changes associated with hemorrhagic shock.

The method which has been developed to meet this problem is based on the assumption that the tolerance of any given animal to hemorrhage may be gauged by the bleeding volume. The unanesthetized dog is subjected to a rapid blood loss practically equivalent to its bleeding volume by allowing the blood to run freely from a femoral arterial cannula (as large as compatible) until it flows only in driblets and the animal is in a state of functional decerebrate rigidity. The first 25% of this volume having beeen collected in large syringes containing heparin is immediately returned through the femoral vein or via the bleeding tube and arterial cannula. In the present series 12 ml blood samples were taken for analysis every half-hour after the hemorrhage. The animals were kept in the supine position throughout the experiment.

The average time for the determination of the bleeding volume was 7 minutes, and for the reinfusion, 1¾ minutes. The average survival time for 21 dogs in which shock was induced by this method was 3 hours, 40 minutes (range 1¼ to 5¾ hours, standard deviation 18 minutes). The bleeding volumes of these animals averaged 62.4 ml per kilo of body weight, or 70.7% of the measured blood volume. Blood volume determinations on 10 dogs made 1 to 3 hours after hemorrhage showed an average reduction of 45.3% from the control value (range 40.4 to 47.5%). This is in agreement with the results from a larger series of dogs bled by removing a fixed quantity of blood per unit of body weight. From the unpublished data[1] of these experiments it was established that the animals which died as the result of a single massive hemorrhage had suffered a blood volume reduction of 40% or greater.

Unanesthetized dogs which were subjected to the loss of 75% of their bleeding volume by the method described here showed the clinical course, the pathology, and all the changes in blood chemistry characteristic of hemorrhagic shock.

* This work was done under a contract recommended by the Committee on Medical Research between the Office of Scientific Research and Development and Columbia University.

1 Walcott, William W., to be published.