are without practical significance, it is interesting to note their effects on the central nervous system. It seems likely that most of the peripheral effects observed are the result of central action but complete analysis of the manner of action has not yet been made. The anesthetic employed appears to possess a quantitative influence on the circulatory but not so much on the respiratory action. With ether anesthesia in cats there is less hypertension after substance N-123 than with Alurate anesthesia. The substance had very little influence on respiration in morphinized rabbits, but in cats under Alurate or ether anesthesia there was marked respiratory stimulation. As is true with most substances acting as biological catalysts (enzymes, vitamins, hormones) the safety margin of its antihemorrhagic effect is enormous. All doses are for the crystalline product containing a moisture equivalent of 6 molecules of water.

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Effects of Spinal Anesthesia upon Venous Pressure in Man.

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(Introduced by Stevens J. Martin.)
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The fall in arterial pressure accompanying high spinal anesthesia in man has been widely investigated. Although paresis of sympathetic fibres with dilation of the arterioles has been regarded as the mechanism for the fall, a recent report by Smith and co-workers[1] indicates an autonomous control of the arterioles of the viscera. They postulate that circulatory failure is primarily venous failure. A fall in venous pressure would be expected. Venous pressures during spinal anesthesia have been reported by Schuberth[2] and Seevers,[3] Goldfarb, *et al*,[4] but the observations have been either on animals or isolated readings in the course of anesthesia for man and there is no agreement among these authors. No studies have been found that correlated arterial tension, with venous pressure and the extent or

1 Smith, H. W., Rovenstine, E. A., Goldring, W., Chasis, H., and Ranges, H. A., *J. Clin. Invest.*, 1939, **18**, 319.

2 Schuberth, O. O., *Acta Chir. Scandinav.*, 1936, 78 supp., **48**, 1.

3 Seevers, M. H., and Waters, R. M., *J. A. M. A.*, 1932, **99**, 961.

4 Goldfarb, W., Provisor, B., Koster, H., *Arch. Surg.*, 1939, **39**, 429.

height of anesthesia. This investigation was undertaken to supply these data.

Procedure. Twenty normal male subjects undergoing extra abdominal operations in the supine position were used to compile these data. Anesthesia was induced by a standard technic using 150 mg of a 10% solution of procaine in spinal fluid. It was injected in the second lumbar interspace. Levels of sensory anesthesia were deter-

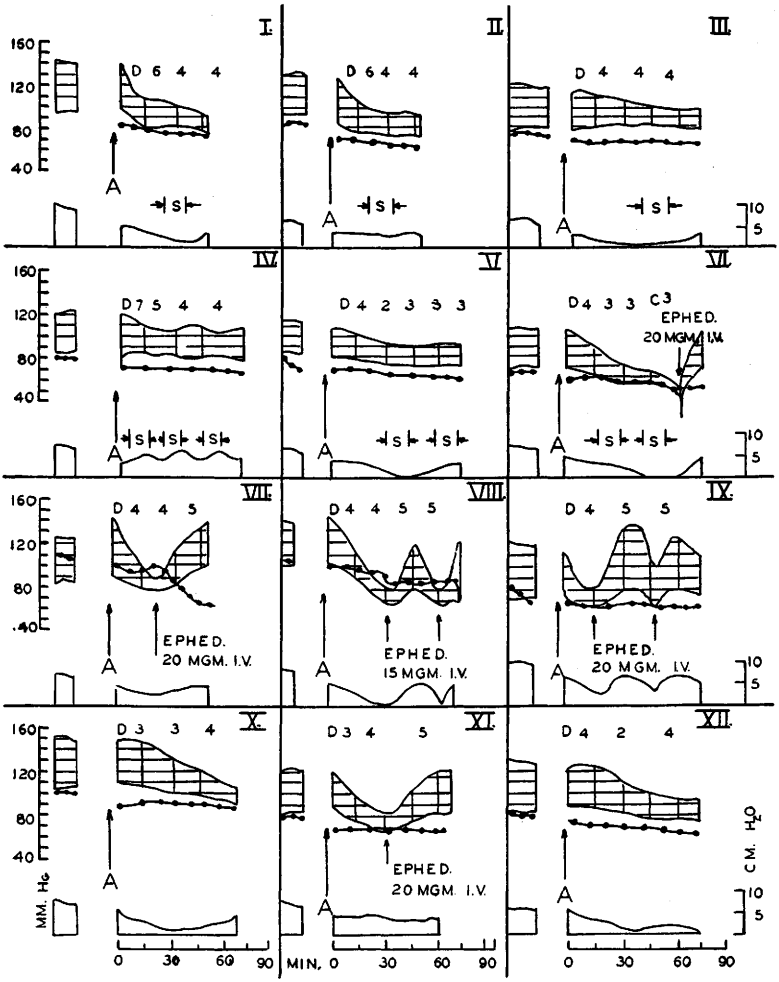

PLATE I.

The blood pressure in mm Hg (upper graph), the pulse rate (dotted line), and the venous pressure in cm H_2O (lower graph) during spinal anesthesia in man. The height of sensory anesthesia is indicated by D_6–, D_5–, etc., at the top of each figure. A– indicates induction of anesthesia and ←S→ period of faradic stimulation to large muscles.

mined according to the classification of Foerster.[5] Direct venous pressure measurements were taken from veins in the antecubital fossa using a modified Moritz-Tabora technic which allowed minute to minute observation throughout the course of anesthesia. Control readings were recorded for a 15 minute period prior to induction. Arterial pressures and pulse rates were also noted.

Results. In 12 subjects anesthesia extended to or beyond D_4 and was accompanied by intercostal paralysis (Plate 1). In 8 subjects it was below this level and accompanied by intercostal activity. The latter were considered as low spinal anesthesias. A consistent immediate fall in venous pressure accompanied high spinal anesthesia amounting to 25% of the control level. Decreases in the arterial pressure were accompanied by further lowering of venous pressure which paralleled arterial pressure fall. In 4 instances the pressure reached zero. (Fig. 5, 6, 8, 12). In low spinal anesthesia the changes in venous pressure were inconsistent. No changes were recorded in 3, there was a rise in 2 and a fall in the remaining 3. In 4 of 5 cases in which intravenous ephedrine was given (Fig. 6, 7, 8, 9, 11), there was a parallel rise in venous pressure and blood pressure. The fluctuations of venous pressure normally seen with respirations were absent or markedly decreased in excursion during anesthesia.

The effects of stimulating muscles of the lower extremity were observed by supplying a faradic current interrupted 30 times per minute, to moist foil electrodes wrapped about the legs and lower abdomen.[6] No significant rises in arterial or venous pressures were obtained in 5 of 6 experiments. (Fig. 1, 2, 3, 4, 5, 6). These results are not in accord with the expression of Ornstein on the value of faradic stimulation of large muscles to counteract decreased arterial tension.[6]

Summary. A decrease of venous pressure follows spinal anesthesia accompanied by intercostal paralyses irrespective of arterial pressure changes. A further decrease accompanies a fall of arterial pressure. No consistent changes accompanied low spinal anesthesia.

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[5] Foerster, O., *Brain*, 1933, **56**, 1.

[6] Ornstein, G., *Anes. and Anal.*, 1940, **19**, 157.