A METHOD FOR ACCURATELY MEASURING THE RATE OF FLOW OF INTRAVENOUS FLUIDS *

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To obtain accurate results of intravenous procaine administration during research study (our findings to be published at a later date) it is necessary to have a measuring apparatus that will accurately control the rate of flow of parenteral fluids throughout the administration. The accurate control is not essential but is a convenience during the clinical application of this therapeutic measure. Foregger (1) described the use of the rotameter for gases. This report deals with its use for the measuring of liquids.

A precise measurement of low flows is most important because predetermined milligram doses are administered over a fixed period of time. The drop method with standard infusion clamp was employed, but found to be too tedious and inaccurate. Various other types of apparatus, such as meters and specially constructed clamps, were considered, but found to be inadequate or too cumbersome for accurately metering extremely low flow rates. Investigation led to the rotameter (figs. 1 and 2) which seemed to fulfill the particular needs.

The rotameter is a flow rate metering instrument wherein fluid is discharged under controlled head conditions through an annular aperture of controlled variable size. The theory of the rotameter (2), therefore, depends on the laws governing the flow of fluids through apertures. In the case of the rotameter, an annular aperture or orifice is formed between the periphery of the head of the float and the inside wall of the tapered tube in which it travels. The upward and downward forces acting on the float are in equilibrium so that the float assumes a definite elevation at a given flow rate. Inasmuch as the net weight of the float is the same at all elevations, it follows that the pressure drop across the float must also be constant. On the other hand, since the tube is tapered, the annular cross sectional area for flow is variable. Increasing flow rates do not, therefore, increase the pressure drop across the float, but cause it to take higher positions in the tube and thereby provide greater flow areas.

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The rotameter provides the following advantages: (1) It is a relatively simple apparatus containing only one movable part. (2) The tube is of Pyrex glass which is easily sterilized either by autoclaving or by boiling. (3) It provides instantaneous response to flow rate changes, enabling one to set desired flow rates and easily discern any deviations during administration. (4) A high degree of readable accuracy is obtained since relatively large changes in float position represent small flow changes. (5) Should the flow of fluids be interrupted for any reason, this is instantaneously indicated by the float of the rotameter which drops to the seat at the bottom of the graduated Pyrex tube.

Rotameters calibrated for liquids of any specific gravity are available. The instrument used for the following determinations was calibrated for a liquid of a specific gravity of 1.0. In using isotonic saline solution as a solvent for procaine hydrochloride, in 0.1 per cent or 0.2
per cent solution, the error factor is less than one-half of 1 per cent. The range of the meter is between 5 and 50 cc. per minute. Quantities as small as 0.2 cc. per minute may be measured with the instrument. A liter flask of isotonic saline solution containing 0.1 per cent of procaine hydrochloride is attached to a regular intravenous set in which the rotameter is interposed between the flask and the needle.

Therefore, if it is desired to administer 4 mg. per kilogram of procaine hydrochloride over a twenty-minute period to a patient weighing 70 Kg., the total dosage of drug would be 280 mg. or 280 cc. of a 0.1 per cent solution of procaine. The flow should be 14 cc. per minute (280 cc. divided by 20 minutes).

SUMMARY

1. The principles of the rotameter are discussed.
2. The use of the rotameter for measuring flow of liquids is described.

REFERENCES

2. Fischer & Porter Company: The Theory of the Rotameter, Catalog Section 98–Y.

At the last meeting of the Canadian Anaesthetists Society, Quebec Division, held on May 3, 1947, the following members were elected to fill the following charges:

1. Representatives at the National Counsel of the Canadian Anaesthetists Society:
   The President elected of the Quebec Division: R. Rochette, M.D., Harold Griffith, M.D., and George Cousineau, M.D.

2. To the Executive of the Canadian Anaesthetists Society, Quebec Division:
   President—R. Rochette, M.D.
   Vice-President—F. H. Wilkinson, M.D.
   Secretary-Treasurer—M. Clermont, M.D.
   Assistant Secretary-Treasurer—J. Beaudry, M.D.
   Counsellors—H. R. Griffith, M.D.; George Cousineau, M.D.; Eugene Allard, M.D.; M. Legare, M.D., and J. L. Rochefort, M.D.