THE ALDON BAG FLUTTER VALVE

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During closed drainage of the bladder of a patient who had recently undergone excision of a diverticulum, it was noted that urine leaked from the suprapubic wound whenever the collecting bag was full. Closed drainage with an indwelling catheter was used because this method reduces bacterial contamination (Webb and Blandy, 1968), and an Aldon\(^1\) bag was chosen because its non-return valve prevents reflux of urine up the catheter. This system works well when the collecting bag contains a small volume of urine, but it seemed to us that the continuing suprapubic leak in our patient might have been caused by a rise in pressure within the system which prevented urine passing through the valve.

This one-way valve is an example of a type of valve, postulated as the mechanism for continence of the gastro-oesophageal (Cramer et al., 1959) and anal junctions (Phillips and Edwards, 1965), which Edwards described best by the term flutter valve. The purpose of this study was to analyse the yield pressure of the flutter valve in relation to the volume of fluid in an Aldon bag.

Materials and Methods.—Aldon bags were suspended from the edge of a table and filled with water from a 3,000 ml. reservoir 30 cm. above the lower level of the bag. This simulated the normal drainage of a patient’s bladder while in bed. Open-tip, water-filled catheters (internal diameter 1·1 mm.) were placed in the collapsed part of the flutter valve and at 5 and 10 cm. above it in the non-collapsible integral connecting tube. Pressure measurements were recorded through SE 481 transducers on an SE 2005 ultraviolet recorder. After calibration and equilibration with atmospheric pressure a continuous recording of the pressures in and above the valve was made while the bag filled freely with water from the reservoir. The change in pressure was noted as each 100 ml. of water was added, as shown by the external calibrated marking, until the bag would hold no more. Most bags were full after about 10 minutes, and then each one was emptied into a glass cylinder so that the true content of water could be measured and correlated with the apparent volume as marked on the calibrated scale printed on the bag. This procedure was carried out on 3 new Aldon bags and then repeated a second and third time. Two other new bags were filled for the first time over a period of 20 hours to reproduce normal bladder drainage conditions, and then tested in a similar fashion.

Results.—The mean pressure in the collapsed flutter valve was equal to atmospheric until the apparent volume had risen to 700 ml. (Fig. 1). At these low volumes the valve functioned efficiently, but above 1,000 ml. the pressure increased markedly. In these experiments most bags could not be filled beyond an apparent volume of 1,350 ml., because the hydrostatic pressure of the head of water filling the bag was equal to the pressure in the flutter valve.

The external markings on the Aldon bag were unreliable. The difference between the true content and the apparent volume on the outside of the bag became greater as the bag filled (Fig. 2). The bag always contained more fluid than indicated by the external markings.

These results were found when bags were tested after they had been stretched, either by rapid filling over 10 minutes to the 1,350 ml. mark, or if they had been left for 20 hours partially filled. If, however, new unstretched bags were filled rapidly, the true and apparent volumes were almost the same.

\(^1\) Aldon urine drainage bag type “CV” (Messrs Aldington Laboratories, Ltd).
Fig. 1
Pressure in the flutter valve of Aldon bags related to apparent volume (mean of 6 experiments).

Fig. 2
True and apparent volumes compared in Aldon bags (mean of 6 experiments).
DISCUSSION

These results show that pressure in an Aldon bag is low until the volume exceeds a critical level, above which it rises steeply. We have found this pressure to start rising when the volume in the bag is 700 ml, as marked on the printed calibrated scale. The flutter valve is compressed and can then only be forced open by a column of fluid with a hydrostatic pressure which is higher than that squeezing it. Normally the pressure to be exceeded is very small but when an Aldon bag is full it may rise to more than 20 cm. H_2O, at which stage a longer column of fluid than normal must accumulate in the catheter to force the valve open. This will lead to stasis in the catheter, impaired bladder drainage and delayed healing of cystotomy wounds.

In practice therefore it is proposed that:

1. Aldon bags must be emptied or replaced regularly so that they do not fill with more than an apparent volume of 800 ml urine.
2. For accurate urine measurement the bags should be emptied into a calibrated container and no reliance placed upon the graduated scale on the bag.
3. It is only safe to allow a patient to wander around with an Aldon bag fastened to his dressing gown cord if the bag is emptied regularly and lowered occasionally to permit the hydrostatic pressure of the urine to force the one way flutter valve.

The practical advantages of these bags seem to us so great that they outweigh any theoretical objections and if these suggestions are noted, they are safe.

SUMMARY

An Aldon urinary drainage bag, with a one-way flutter valve to prevent reflux, fills easily until a critical point is reached at which increasing pressure within the bag prevents drainage through the valve. The calibrated markings on the bag are unreliable and underestimate the true content. Such bags should not be allowed to fill beyond the level at which pressure within the bag begins to rise, if urine is to drain freely.

The initial observation was made on a patient under the care of Mr G. C. Tresidder to whom we are grateful. The manufacturers of the Aldon bag are now modifying its design. The prototypes will be submitted to further testing.

REFERENCES