A New Six-way Stopcock

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The three-way stopcock is a commonly used tool in the clinical practice of anesthesia. This device, used singly or in a manifold arrangement, enables the physician to set up in-series two or more intravenous solutions or syringes. The stopcock is also useful in venous, arterial and audio-monitoring lines to control the direction of pressure or sound impulses.

Virtually every stopcock available today has the same disadvantages: 1) they require two hands to operate; 2) when used singly, only one inflow port can be opened at a time; 3) when used in a manifold arrangement, they are cumbersome and unstable; 4) the fluid stream must invariably turn through a right angle when the side channel is selected, and resistance to flow is thereby increased; 5) channel identification and selection are accomplished only after careful visual study of the device. This is a potential source of distraction and time loss to the clinician.

It occurred to the author that a stopcock that would overcome most of these disadvantages could be constructed. Subsequently, the author collaborated with Ethnor Medical Products in the development of a new six-way stopcock† intended to achieve this objective. This six-way stopcock was then critically evaluated at our institution.

The device is shown in figure 1. There are six possible selection options: 1) the intravenous infusion line alone may be chosen by turning the pointer toward the center post; the syringe on the right (2) or that on the left (3) may be selected; the intravenous infusion line may be used together with (co-flow) the syringe on the right (4) or that on the left (5), or the valve may be turned off entirely (6). These positions may be identified and selected by digital palpation without visual reference to the valve by aligning the pointer with the appropriate post or gap-between-posts. Each position has a definite resistance-type, soft-click stop. This facilitates channel selection and helps prevent inadvertent pointer changes. Nevertheless, the pointer is easily turned with one hand. The angle through which the fluid must turn is 30 degrees, and the diameters of the ports and orifices within the selector mechanism are greater than that of an 11-gauge needle (fig. 2).

The stopcock may also be used in series to accommodate as many selector valves as needed. Each additional valve furnishes the user with an additional pair of inflow ports, and the syringes may be replaced with intravenous infusion lines. The flat shape of the valve and the presence of side wings stabilize the valves and provide the user with a ready method for securing the device to a table or arm board.

Flow characteristics and leak potential were studied in 70 Ethnor stopcocks using 70

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† The device is available for purchase from Ethnor Medical Products, Somerville, N.J. 08876.

FIG. 1. Six-way stopcock used with an intravenous infusion line and two syringes. 1, 2 and 3 are single-flow channels, 4 and 5 are co-flow channels, and 6 is off. All ports are Luer Lok.
standard three-way stopcocks as comparative controls. The studies were carried out under identical conditions for both valves. The following method was employed.

The test cell was a constant-head, metered system consisting of a reservoir with the water level 12 inches above the valve test position. Water was fed from the reservoir into a Gilmore #3 calibrated flowmeter via ½-inch I.D. polyvinylchloride tubing. The exit side of the flowmeter was fitted with intravenous tubing which terminated in a standard needle adapter. Both tubing and adapter were obtained from a commercially available blood-administration set. The test procedure was initiated by recording the meter reading for flow through the unrestricted system (approximately 130–160 ml/min). Next, the valve, in the open position, was placed on the needle adapter and the flow allowed to equilibrate for 15 seconds. The meter reading was then recorded and the difference between readings used to calculate the percentage reduction in flow induced by the valve. The procedure was repeated for each flow position of both valves. To test for leaks, both valves were interposed into separate, but identical, blood-administration sets, i.e., Fenwal blood bag, with filter, stopcock, 20-inch extension tubing and plastic 18-gauge intravenous catheter. The blood bag was enclosed in an inflatable pressure infusor.

RESULTS

Maximum reduction in flow rate through all channels in the Ethnor stopcock was 16 ± 2 per cent; through the standard stopcock, 26 ± 5 per cent when the side port was selected and the fluid traveled through an angle of 90 degrees. No leak was detected in the Ethnor stopcock when pressures of 330–350 mm Hg were imposed on the system by the pressure infusor for five minutes. Five (7 per cent) of the standard stopcocks leaked at these pressures.

1 Pharmaseal, Inc., Toa Alta, Puerto Rico 00758.

Fig. 2. Six-way stopcock from the bottom, showing three input ports and channels and selector mechanism.

The Ethnor stopcock is somewhat more bulky and heavier than the standard three-way stopcock, but these characteristics are offset by the fact that the device is easily secured to a flat surface. As with the standard stopcock, the Ethnor device can be used to direct pressure and sound impulses during venous, arterial and audio-monitoring. In this usage, three channels are available with the Ethnor stopcock and two with the standard three-way stopcock. Each inflow port in the Ethnor stopcock has a deadspace of 0.4–0.6 ml. Therefore, it is important to purge the unit prior to use and to flush through drugs which are administered in small volumes. This six-way stopcock has proven to be a useful clinical tool with which the operator can handle accomplish easy, reliable channel selection with one hand, without visual reference to the device. The principal drawbacks are its size and the deadspace in the inflow ports.

The author expresses appreciation to George Lopac, B.M.E., and Tim Rudko, B.E.E., for their help in designing and performing the flow and leak studies described herein.