

Results obtained indicated differences between actual and predicted drug infusion time vary by a minimum factor of two and maybe sixty or higher.

The use of micro-bore tubing within the IV infusion line ending at the male luer adaptor which connects to the patient's catheter resulted in substantially reduced drug residence within the IV infusion line.

In the initial experiments in which the administration set was held in the vertical position, clearance times for sugar solutions were significantly lower than for alcohol solutions. When a slight rise (one inch) was introduced into the tubing set downstream from the injection site, the sugar solution clearance time substantially increased.

In all experiments performed, the use of a micro-bore tube resulted in a minimum one order of magnitude difference in clearance time when compared to test solutions injected directly into the IV line.

After injection of test solutions, the clearance time for both sugar and water was very rapid. Clearance time for alcohol solutions was somewhat longer. However, when the male luer adaptor of Test Configuration II was inverted such that the outlet faced up, the clearance time for alcohol solutions dramatically dropped. This effect is due to the alcohol solution having a lower specific gravity than the primary solution.

Various modifications may be made in the extension sets. For example, in order to feed two drugs continuously or intermittently to a patient, two micro-bore tubes can be used. This would eliminate the potential of in-line incompatibility, for example where one drug might precipitate in the presence of the other drug, while providing for the patient to receive both drugs simultaneously.

The drug conveying tube can be made of any suitable material, for example polyethylene, Teflon, or other non-absorbing or non-reacting plastic. Further, the drug conveying tube or lumen may be made from an opaque plastic such as barium sulfate filled Teflon to allow the infusion of light sensitive drugs. Further, in order to inject a series of drugs, for example followed by a "chaser" such as water or a normal saline solution, a multi-lumen connector can be used at a Y-connector.

The invention thus provides an extension set which is capable of infusing a drug directly into a patient with little or no hold-up time. Further, a drug can be administered at a predetermined dosage, a predetermined rate and over a predetermined interval of time.

Further, the invention provides an extension set which can be readily used in a simple reliable manner.

Still further, in the case where the extension set is of the self-priming type as illustrated in FIGS. 1 to 4, bubbles of air can be eliminated in the extension set so as to permit use in delicate situations, for example for premature pediatric patients.

In any of the above-described embodiments, the hydrophilic filter may be bacteria retentive, e.g., with a pore size small enough to prevent bacteria from passing through. Thus, the extension set can be characterized as a closed system, i.e., a system which during hook-up to a drug syringe pump will not allow bacteria to enter.

Of note, the structure as shown for example in FIG. 9 may be used to withdraw blood without the need for stopcocks and drawing blood thru the primary line in such applications as invasive blood pressure monitoring and conventional IV administrations hook-up. For the case of invasive blood pressure monitoring there would be no need to shut the system down as is currently done

nor would there be any danger of clogging the primary line as sometimes occurs. Being readily available and a simple procedure, blood sampling would be more reliable and simple to use

What is claimed is:

1. An extension set comprising means defining at least two lumen, one of said lumen being sized to convey an intravenous fluid therethrough and the other of said lumen being sized to convey a drug therethrough; and a common connector receiving each lumen, said connector having means at one end for connecting to a catheter to deliver an intravenous fluid and a drug thereto, a pair of sockets receiving said lumen therein and a partition wall between said sockets and extending to said means at said one end of said connector.

2. In combination,

a catheter having a needle for implanting into a patient;

an extension set connected to said catheter, said set including a connector removably secured to said catheter, a first lumen terminating in said connector for delivering an intravenous fluid thereto for passage into said connector and a second lumen terminating in said connector for delivering a drug through said connector into a patient;

an interfacing chamber within said connector extending from said first and second lumen to said needle, said chamber having a volume to contain no more than two drops of the delivered drug;

first means connected to a distal end of said first lumen to deliver a flow of intravenous fluid thereto; and

second means connected to a distal end of said second lumen to deliver a flow of drug thereto.

3. The combination as set forth in claim 2 wherein said second lumen is disposed within said first lumen along a length extending from said connector to a point of separation of said lumen.

4. The combination as set forth in claim 3 wherein said second lumen has an internal diameter of 0.020 inches.

5. The combination as set forth in claim 2 wherein said extension set has an elongated flexible double-tube lumen defining said lumen with said lumen being disposed in side-by-side relation.

6. The combination as set forth in claim 2 which further comprises a hydrophilic filter in a distal end of said second lumen to prevent passage of air into said second lumen.

7. The combination as set forth in claim 3 wherein each lumen is disposed in a tube of a length of from 2 to 4 feet.

8. A method of administering a drug comprising the steps of

connecting a first lumen of an extension set to a catheter implanted intravenously in a patient to deliver a flow of intravenous fluid to the patient at a predetermined rate over a period of time; and

introducing a drug at a predetermined rate and dosage for an incremental time through a second lumen of the extension set directly into the patient through said catheter.

9. A method as set forth in claim 8 wherein the drug is interfaced with the fluid flow immediately upstream of the catheter in an interfacing chamber of a volume to contain no more than two drops of the drug.