A Simplified Central Supply System for Haemodialysis

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A central supply system for dialysate should be highly reliable, cheap to build, easy to maintain and versatile enough to accommodate different concentrates. The present system was designed to reach these goals.

PRINCIPLES

Appropriate mixing ratios of concentrate and water are achieved by maintaining strictly constant flow rates of each fluid into a mixing tank. Constancy of the flow rates is obtained by keeping steady the hydrostatic pressure under which the fluid flows through a membrane with precalibrated holes. Stability of the hydrostatic pressure results from a constant level difference between the membrane and a constant level head tank containing either water or concentrate.

DESCRIPTION (Figure 1)

Water is stored in a tank (1) equipped with two level switches regulating the flow of water into the tank. A centrifugal pump (2) delivers water into a head tank (3) in which a constant level is maintained by an overflow system. Concentrate is stored in a second tank (4). It is delivered by a pressure pump (5) to a head tank (6) where a constant level is achieved by an overflow. The concentrate is kept free of particles by two filters placed before (7) and after (8) the pump. The concentrate is pumped through a T tubing designed to prevent air bubbles from clogging the system when the pump is restarted. Resistance of the pipe leading to the overflow tank is minimal so that only the hydrostatic pressure between the level in the head tank (6) and the concentrate membrane (H2) drives concentrate through the membrane into the mixing chamber (9). An electrovalve (10) closes the pipe when the pump stops and thus prevents the concentrate from flowing back into the tank. The concentrate head tank is designed so that the level of concentrate can be modified if a different mixing ratio is desired. The volume of the water
Figure 1. Schematic representation of the simplified central supply system.
head tank can also be modified by a piston so that the ratio of the volumes of the two tanks remains equal to the desired mixing ratio. As a result, when the pumps stop functioning, the emptying of the two head tanks into the mixing chamber produces an adequate dialysate. The water and concentrate pipes are closed by stainless steel membranes perforated by a varying number of identical holes: 1 for the concentrate membrane, 31 for the water membrane.

Dialysate flows from the mixing chamber into the mixing tank (11) where its composition is checked by a conductivity meter (12). From the mixing tank dialysate is then delivered to a distribution tank (13) equipped with two level switches controlling the water and concentrate tank pumps.

RESULTS

The production of dialysate reaches 15 l per minute. Variations in conductivity are below 100 μmho.

In 2540 hours of working, alarms required the intervention of a nurse on five occasions: twice for reasons unrelated to the system (city water faucet closed, empty concentrate tank), once for failure of the concentrate pump and twice, immediately after the assembly of the system, because teflon particles had occluded a few holes of the water pipe membrane.

In our experience the system has proved:

1. reliable
2. of low cost
3. easy to maintain as there are virtually no moving parts
4. completely noiseless.

SUMMARY

A low cost, efficient central supply system for haemodialysis is described. Its basic principle is the maintenance of a constant level of water and dialysate in head tanks so that flow rates of each fluid are determined only by the resistance of the tubing.

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