Erythrocytes Combined with Albumin as Volume Markers in Experimental PD Used to Measure the Tissue Albumin Space

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INTRODUCTION AND AIMS

Volume markers are used to follow the ultrafiltration process in experimental peritoneal dialysis (PD). An ideal volume marker is confined to the peritoneal cavity and can therefore be used to measure the kinetics of net ultrafiltration. Labeled albumin, the most frequently used volume marker, distributes to a larger volume that also includes the surrounding tissue. The present study was performed in order to evaluate labeled erythrocytes as intraperitoneal volume markers and combine them with labeled albumin in order to measure the tissue albumin space in relation to tissue edema.

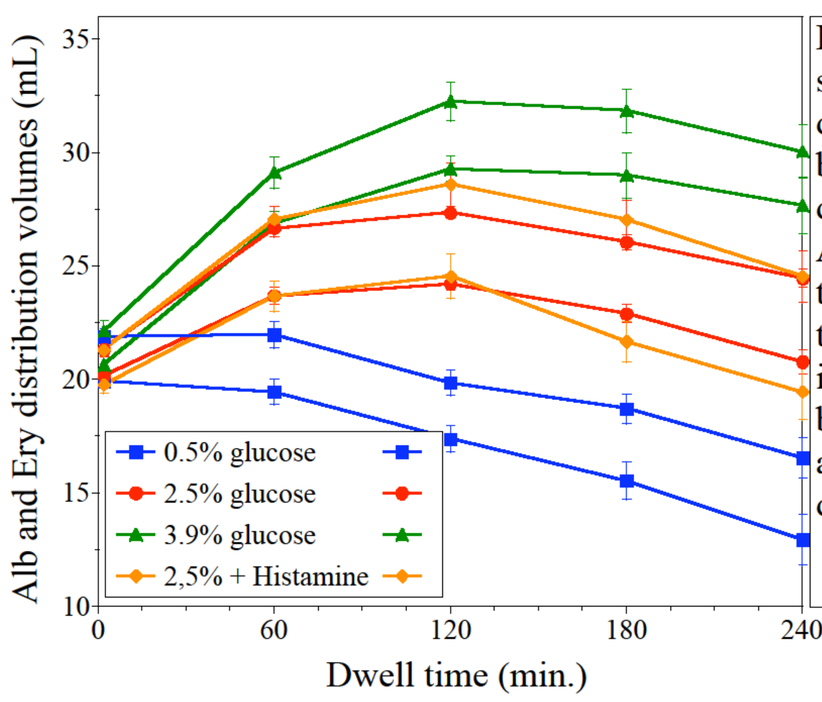
CONCLUSIONS

- Labeled erythrocytes are reliable markers of the intraperitoneal volume during peritoneal dialysis.
- Experimental models based on this concept offer new possibilities for kinetic studies of transperitoneal transport.
- Combining erythrocytes with labeled albumin allowed a characterization of the tissue volume engaged by different PD fluids in the presence and absence of edema.

RESULTS

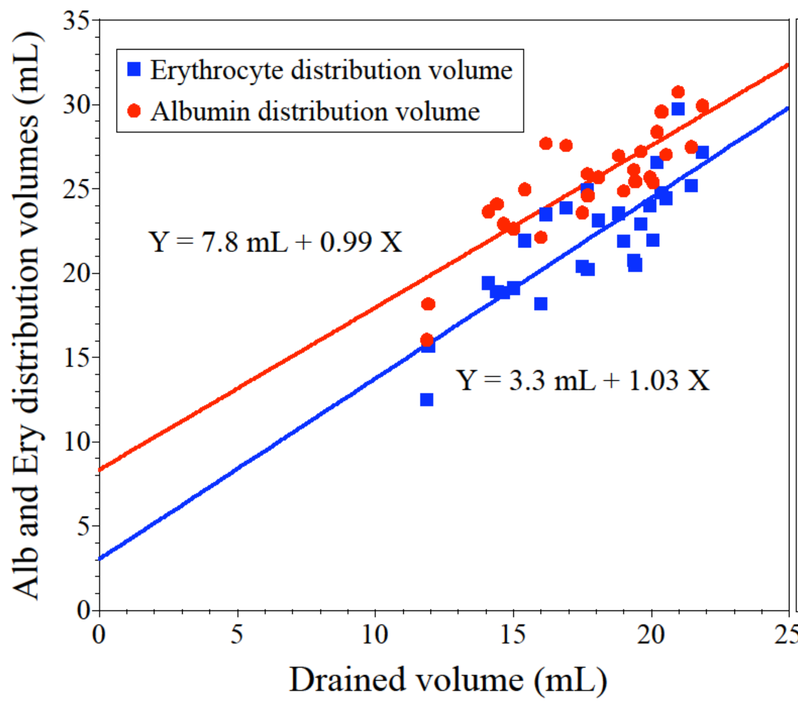
Erythrocyte distribution volumes were used to measure intraperitoneal fluid volumes since measured drained volumes and washout data from the peritoneal cavity and from tissue biopsies indicated that the error was smaller than 1.5 mL.
Thus, the difference between erythrocyte and albumin distribution volumes could be used to estimate the extracellular tissue volume that, over time, was accessible to labeled albumin: ”the tissue albumin space”.
This space increased rapidly to 1.5 mL during the first minutes of the dwell and then slowly expanded, finally reaching 4 mL during a normal dwell. For histamine supplemented PD fluid, the tissue albumin space reached a maximum of 5.4 mL after 3 hours dwell.

Kinetics of erythrocyte and albumin distribution volumes



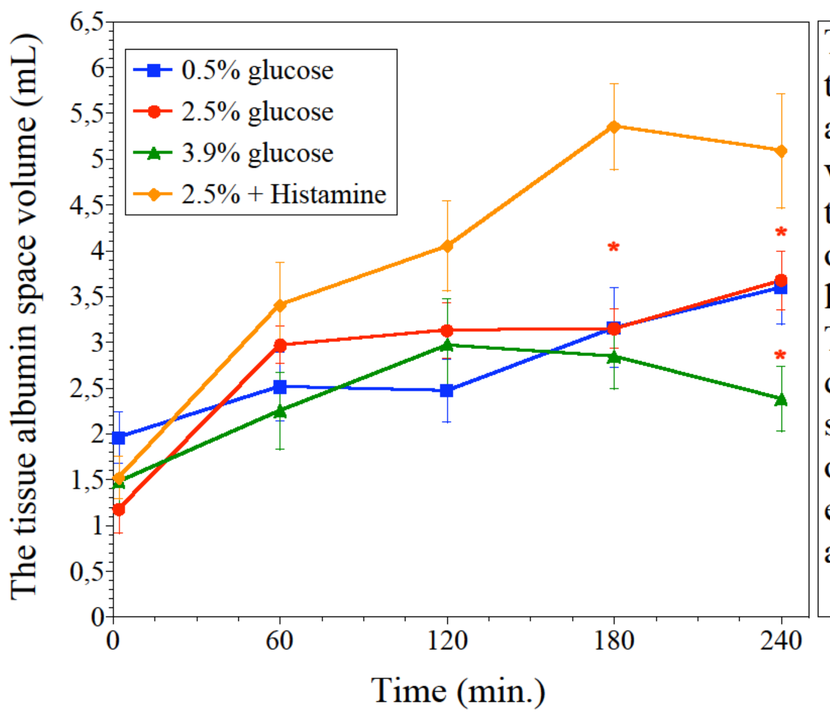
Each pair of graphs shows the erythrocyte distribution volume below the albumin distribution volume. Addition of histamine to the PD fluid created tissue edema that increased the difference between erythrocyte and albumin distribution volumes.

Correlation between distribution volumes and drained volumes



Erythrocyte and albumin distribution volumes at the end of the dwell both correlated significantly with drained volumes. The 3.3 mL difference between erythrocyte distribution volume and drained volume could be reduced to 1.5 mL by rinsing the peritoneal lining.

The tissue albumin space: effects of histamine and osmolarity



The difference between the erythrocyte and albumin distribution volumes corresponds to the tissue volume occupied by albumin-labeled PD fluid. Towards the end of the dwell, this volume is smaller for high osmolarity PD fluid and expands if histamine is added to the PD fluid.

METHODS

Single 4-hour PD dwells in rats were used to compare the distribution volumes of ^{51}Cr erythrocytes and ^{125}I bovine serum albumin with drained volumes. 20 mL of a laboratory-made, filter sterilized, lactate buffered PD fluid was infused by an implanted PD catheter. Three different glucose concentrations (0.5%, 2.5% and 3.9%) were used in order to vary the ultrafiltration volumes. In a separate group of rats, 5 µg/mL of histamine hydrochloride was added to the PD fluid in order to induce edema in the peritoneal tissue. The dialysate was sampled at 0, 1, 2, 3 and four hours dwell time. A blood sample was obtained at the end of the dwell to allow calculations of lymphatic clearance of volume markers.

51ERA-EDTA
462--SP
M) Dialysis. M2) Peritoneal dialysis.
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DOI: 10.3252/pso.eu.51era.2014
Poster presented at: 51 ERA-EDTA CONGRESS AMSTERDAM 2014