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BLOOD VOLUME MONITORING SYSTEMS : WHAT ARE WE MEASURING ?

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Background : Increasing number of dialysis machines have embarked Blood Volume Monitoring Systems (BVMS) that allow displaying a Relative Blood Volume (RBV) curve. RBV is calculated from hemoconcentration's measurement either optical or ultrasonic.
J Dasselaar et al. published (*Clin J Am Soc Nephrol 2007*) : BVMS underestimates RBV values : -8.2% (BVMS) vs -17.3% (gold standard isotopic method). Values given by both methods however were identical during first hour of HD session, then progressively diverged until session's end.
We thus conjectured : isotopic method and BVMS measure different blood volumes.
On the other hand we had devised a simple hydraulic model : with peak and trough filtration, both RBV curves (model displayed and BVMS observed) show identical peak and trough behaviour.
We then conjectured : BVMS measures a volume whose vasculature has a much less complex architecture than global vasculature : this volume might be Central Blood Volume (CBV)

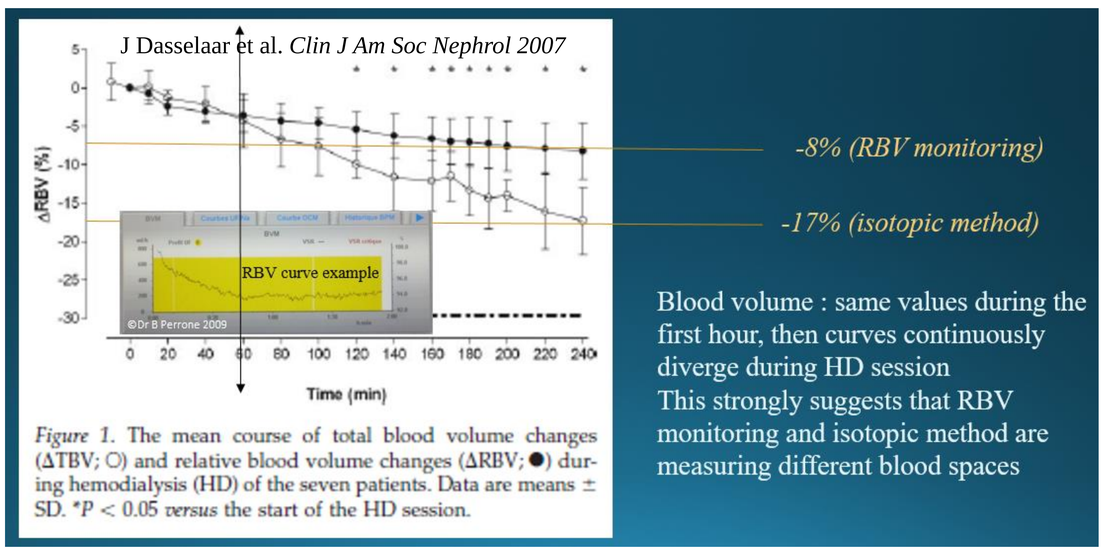
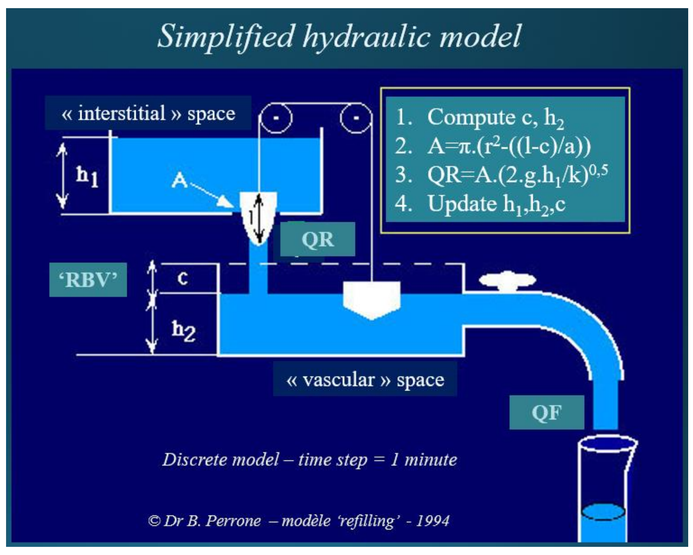
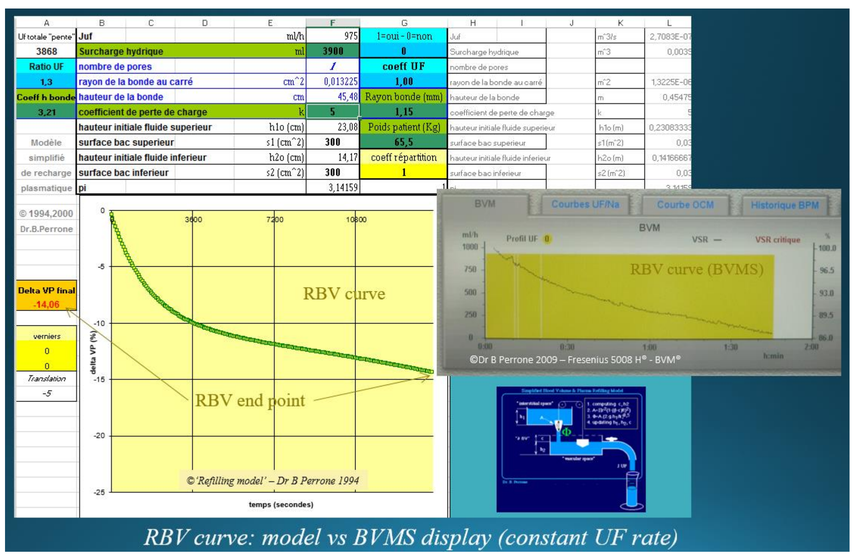
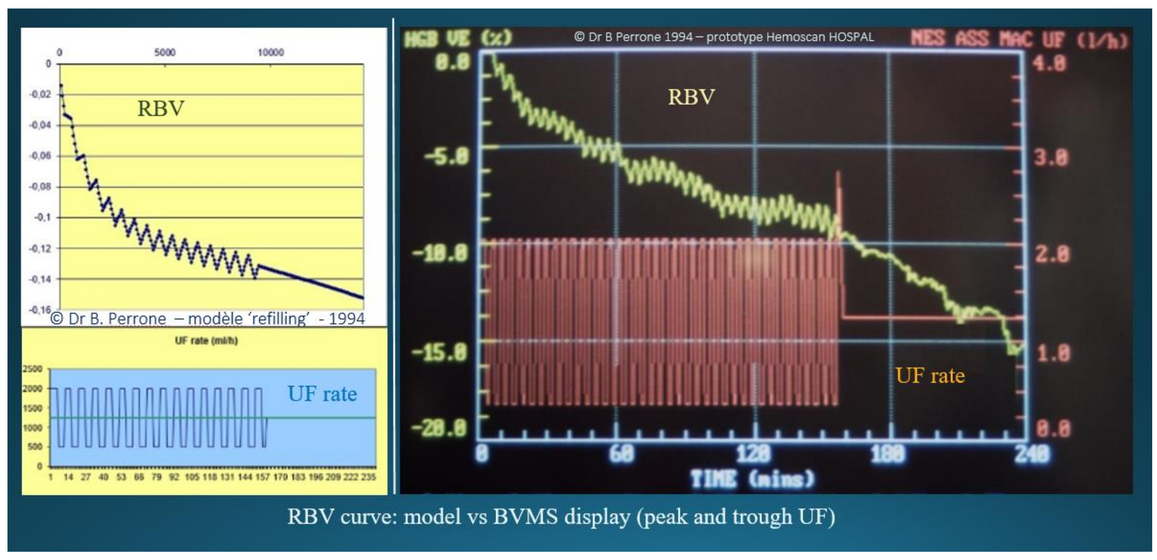


Figure 1. The mean course of total blood volume changes (ΔTBV; ○) and relative blood volume changes (ΔRBV; ●) during hemodialysis (HD) of the seven patients. Data are means ± SD. *$P < 0.05$ *versus* the start of the HD session.





RBV curve: model vs BVMS display (constant UF rate)

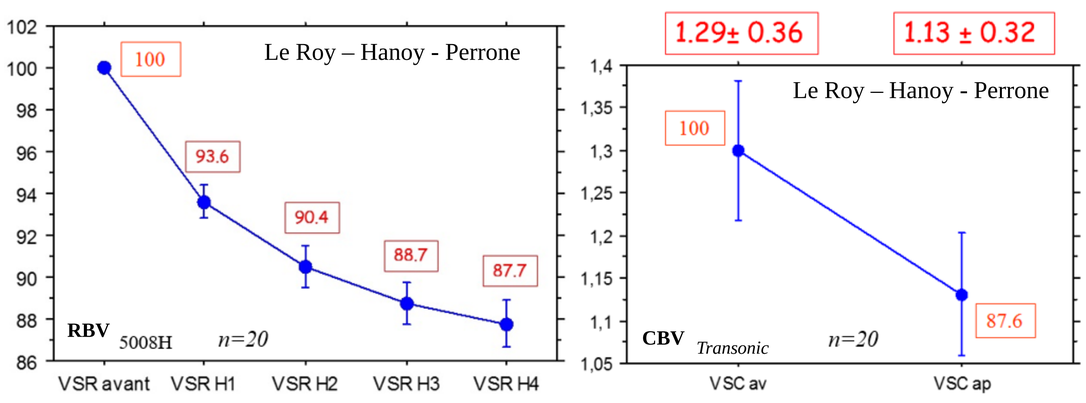


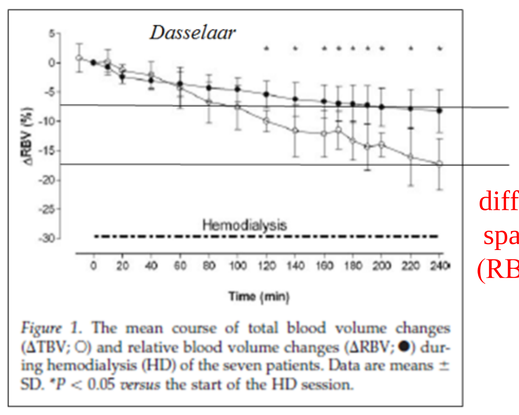
RBV curve: model vs BVMS display (peak and trough UF)

Methods : RBV variation (session's end value : BVM System Fresenius) and CBV variation (start vs end value : Transonic ™ measurement) were compared. *Transonic ™ measurement's main purpose being cardiac output and total peripheral resistance survey.*
N= 20 patients (1 session each patient).
Time on HD 5.2±4.5 years; Age 69.1±15 years ; Body weight 63.9±12 Kg ; Total filtration amount during session : 2397±779 ml
Results : same variation was observed for RBV and CBV

RBV (BVMS): -12.3%±4.9 ; CBV (Transonic): -12.4%±8 [p= 0.75]

correlation however was poor
dRBV = 8.175+ 0.33*dCBV [R^2=0.346]





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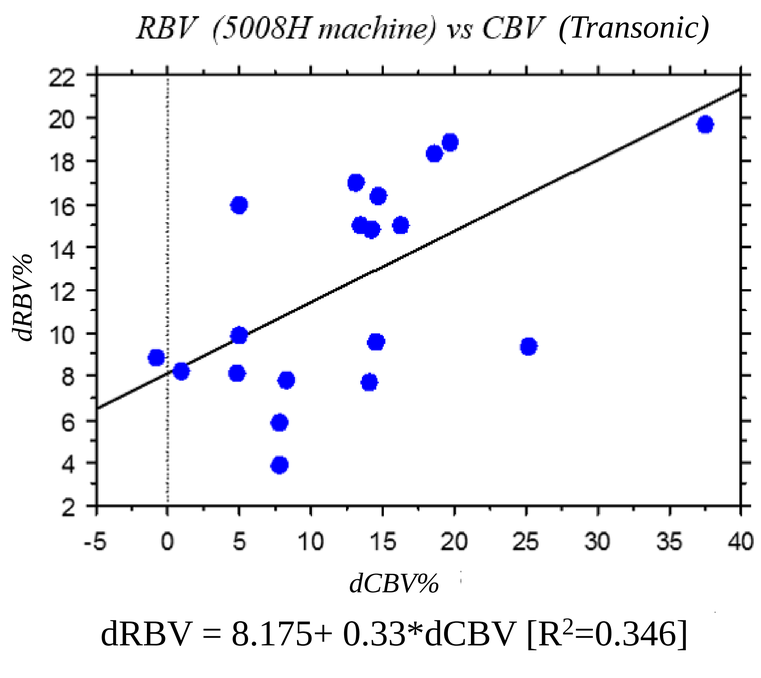
Dasselaar		*Le Roy – Hanoy - Perrone*	
- 7%	*RBV*	*-12,3%*	*RBV*
-17%	*Total BV*	*-12,4%*	*CBV*

different vascular spaces measured (RBV ≠ total BV)

same vascular space measured (RBV = CBV)

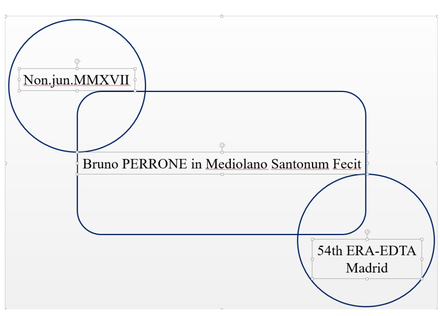
Correlation



dRBV = 8.175+ 0.33*dCBV [R^2=0.346]

Conclusion : BVMS seem to measure CBV variation and not total blood volume variation. Further study with higher number of sessions and same person for operating Transonic™ measurements is needed to confirm preliminary results.

Reference: *Relative Blood Volume Changes Underestimate Total Blood Volume Changes during hemodialysis Judith J DASSELAAR et al. Clin J Am Soc Nephrol 2: 669-674, 2007*



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