Publication Brief

Comparison of different techniques of hemodialysis vascular access flow evaluation

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BACKGROUND
Measurement of vascular access flow has been suggested as a method of choice for vascular access quality monitoring. Besides traditional duplex Doppler, a number of bedside methods based mostly on the Krivitski principle of vascular access flow evaluation from recirculation at reversed needles, have been developed.

OBJECTIVE
To compare ultrasonic dilution (UD-HD01 ref Transonic Systems) with duplex Doppler (DD); thermodilution (TD), BTM, Fresenius; optodilutional recirculation measurement (ORX), Critline III, R-mode, HemaMetrics; direct optodilutional QVA evaluation from jumpwise changes in ultrafiltration rate at both normal and reversed needles connection (OABF), Critline III, ABF-mode; and direct transcutaneous optodilutional vascular access flow evaluation (TQA), Critline III TQA.

METHOD
1. Duplicate measurements at unchanged conditions assessed reproducibility of each method.
2. Paired measurement with each method performed at controlled change in relevant measurement condition (two different extracorporeal blood flows in UD and TD, changed sensor position in TQA).
3. Accuracy of each method was assessed by paired measurements by each method and the reference method performed at identical conditions.

Vascular access flow was manually calculated by the Krivitski formula QVA = QB(1-RX)/RX when needed.

RESULTS
• Very high reproducibility was seen in UD, both for measurements at the same extracorporeal blood flow (QB) and for measurements at two different QB (r= 0.9735, n= 24), justifies its current status of a reference method in vascular access flow evaluation.
• Slightly lower reproducibility of TD measurement at the same QB and at two different QB (r= 0.8508, n= 168) can be easily overcome by duplicate measurement with averaging.
• High correlation of TD vs. UD (r= 0.9543, n= 54) makes TD a viable clinical alternative in QVA evaluation. Consistently different QVA obtained at two different QB should prompt closer investigation of anatomical conditions of the access.
• Use of the simple Krivitski formula in TD (which measures total recirculation, i.e. sum of access recirculation and cardiopulmonary recirculation) brings about underestimation of QVA, which progressively increases from QVA of about 600 ml/min up.
• Good correlation, although with significant scatter (r= 0.8691, n= 27) was found between the DD- and UD-based QVA.
• By far the worst reproducibility at the same QB was found in ORX (0.6430, n= 23). Also the correlation of ORX vs. UD was lower than in other methods (r= 0.702, n=33) and general overestimation of QVA by about 25% was noted.
• Correlation of OABF vs. UD (r= 0.6957, n= 26) was slightly better than that of ORX and it gave less overestimated values.
• The TQA method showed very high reproducibility (r= 0.9712, n= 85), however only for unchanged sensor position. Correspondence of TQA vs. UD was satisfactory (r= 0.8077, n= 36). Skilled and experienced operators are a must with this method.