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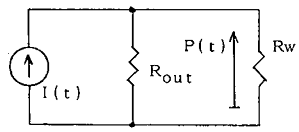
A SIMPLE COST EFFECTIVE PEAK FLOW METER

Aim: A simple and cost effective whistle peak flow meter was designed in order to comply with the financial restraints and difficulty of interpretation experienced by some of the patients attending the paediatric asthma clinic.
Method: A whistle was designed that operates as the electronic equivalent of a current source where I(t) equals the air flow at the inlet

By setting r_{out} (outflow orifice size) the peak flow can be fixed when the whistle will blow. The air flow (current) passing through the whistle resistance will generate a pressure P(t) that will activate the whistle sound at a given flow I(t). By selecting a range of peak flow (50 - 700 l/s) at about 60% of the required value for age and BSA, the patient can be sent home with a whistle than will warn when the peak flow falls below a safe level.



Results: The laboratory peak flow results correlate well with the peak flow generator flows (wave No. 24) r = 0.87, n = 40, and the whistle is well accepted by the patients.

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A 4-COMPARTMENT MODEL OF BODY COMPOSITION: COMBINING DEUTERIUM DILUTION (D_2O) WITH DUAL-ENERGY X-RAY ABSORPTION (DXA)

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AIM: Combining D_2O and DXA allows to assess 4 body compartments (body water, TBW; bone-free lean body mass, BLBM; bone, BMC; fat mass, FM) and to calculate the fat-free solids (proteins) as FFS=BLBM-TBW. We studied the feasibility in adults before the application to pediatric patients. The reference data are compared with TBW, FM and lean body mass (LBM_{DXA}=BLBM+BMC) obtained by the popular, but indirect method of BIA (bio-impedance). **METH:** Simultaneous measurements using D_2O ([1]: oral load, 1.0 ml/kg, ^2H serum enrichment after overnight fast), DEXA ([2]: QDR-1000W, Hologic, USA), BIA ([3]: Akern-101); 38 healthy males: 24±1 y, 71.9±11.4 kg, 178.4±7.1 cm. CV: TBW: 1% (±0.4 L), LBM: 1.5% (±1.0 kg), FM: 2% (±0.3 kg), BMC: 1% (±0.04 kg). **RES:** Mean±sd of the ratio of TBW, BLBM, BMC, and FFS: A) percent BW, B) percent LBM_{DEXA}; C) mean±sd of individual differences between D_2O/DEXA and BIA (***): $p < 0.001$, paired t-test).

mean±sd	TBW [D_2O]	BLBM [DXA]	FM [DXA]	BMC [DXA]	FFS [D2O/DXA]
A) [%BW]	62.8 ± 5.0	81.0 ± 5.0	15.0 ± 5.3	3.9 ± 0.4	18.1 ± 1.5
B) [%LBM]	73.7 ± 2.3	95.4 ± 0.4		4.6 ± 0.4	21.6 ± 2.4
C)$\Delta_{Ref.-BIA}$	TBW: 1.2 ± 1.7 [L]***)		LBM: 1.4 ± 2.3 [kg] ***)		FM: -1.4 ± 2.3 [kg] ***)

DISC: 1) Water content of LBM (D_2O and DEXA) seems to be fairly constant, but slightly decreases with BW. 2) BIA significantly underestimates TBW and LBM with a systematic error and considerable individual variation.

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^1H-MR-SPECTROSCOPY OF THE BRAIN: IN-VIVO MEASUREMENT OF WATER COMPARTMENTS AND DETECTION OF WATER WITHIN MYELIN LAYERS

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AIM: Using differences of T_2-relaxation, ^1H-MRS can measure intra- plus extracellular water within brain tissue (**B** in Tab. 1) and the water fraction of CSF and blood (**C**). In white matter (WM), a third water compartment (**A**) with a short T_2-relaxation is detected and considered to be enclosed between myelin layers. Measuring (**A**) is of potential pediatric interest because myelination during brain maturation might be observed. We present an in-vivo and noninvasive MRS-method to measure the three water compartments and the application in adult volunteers. **METH:** 1.5 T-whole body system, adapted short-echo STEAM, voxel 2 cm^3. Measuring T_2-decay: 22 acq. (TE: 7-10,12,15,20, 25,30-60,80,100,120,160,200,280,360,500,800,1600ms), triexponential least-square fit. Measuring T_1-saturation (TR: 0.4,0.55,0.7,0.9,1.2,2,3s). 10 volunteers (29±3 y), WM: dorso-lat. of post. ventr., n=10; grey matter (GM): occipital cortex, n=3. **RES:** 1).Tests: a) H_2O phantom (0.15mM $MnCl_2$, 0.14 M NaCl): a single compartment is found (T_2=0.13s, T_1=0.97s). b) Water suppressed brain spectra do not show lipid resonances, comp. A reflects water. 2) Tab.1 shows mean±SD for T_2- and T_1-relaxations and for the fraction of the water compartments in WM. The triexponential fit (3 compartments) approximates best as compared to the mono- or biexponential fits (1 or 2 compartments).

compartment	T_2 WM [ms]	T_1 WM [ms]	fraction of WM [%]	T_2 GM [ms]
A (myelin-H_2O)	18 ± 3	0.37 ± 0.08	4 ± 1	
B (tissue-H_2O)	74 ± 6	0.68 ± 0.05	44 ± 6	77 ± 1
C (CSF-,blood-H_2O)	207 ± 46	1.89 ± 0.39	12 ± 5	815 ± 322

3) Compartment A (water within myelin) is **not** observed in grey matter. **DISC:** Using the presented spectroscopic MR-sequence, absolute sizes of water compartments and their T_2- and T_1-times may be precisely measured in white and grey matter. Assessment of the time course of compartment sizes and relaxation times is of interest to characterize brain development or white matter diseases.

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CHANGES OF BODY COMPOSITION IN OBESE CHILDREN DURING WEIGHT REDUCTION (WR) AS MEASURED BY DEUTERIUM DILUTION

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AIMS: 1) To investigate whether physical activity during WR in obese children reduces loss of lean body mass. 2) To establish a group-specific relation between body water (TBW) and bioelectrical impedance (BIA).
METHODS: 67 obese, but healthy children: 23 boys, 44 girls: 13.9 ± 1.8 y, 166.0 ± 10.1 cm, 84.3 ± 17.2 kg, 40-d supervised WR program (1000 kcal/d diet combined with a 2-h sport program every day). After overnight fast, measurement of: 1) body weight (BW), 2) skinfold thickness, sum of 4 sites (SST) using a Houltain caliper, 3) BIA using an AKERN 101, 4) TBW (oral load of 0.4 ml 99.8% D_2O/kg BW, pre-dose urine and 3-h post-dose serum sample, analysis of ^2H enrichment as described [1,2], CV < 1%.)

	BW [kg]	SST [mm]	H^2/I [cm^2/Ω]	TBW [l]	TBW/BW [%]
Start (Day 2)	84.3 ± 17.2	101.7 ± 24.6	54.6 ± 12.6	35.3 ± 6.9	41.6 ± 4.2
End (Day 38)	75.7 ± 14.9	81.9 ± 20.7	53.7 ± 12.8	35.0 ± 6.8	46.2 ± 5.4

RESULTS: see table; linear regression revealed significant correlation (before WR: r = 0.906, after: r = 0.913) between TBW and BIA.
DISCUSSION: 1) TBW is constant during WR, weight loss is merely due to a loss of fat mass. 2) A relation between BIA and TBW was found which was stable during WR.

REFERENCES: [1] Fusch Ch, Moeller H (1988) J Clin Chem Clin Biochem, 26: 715 - 721. [2] Fusch Ch, Spirig N, Moeller H (1993) Eur J Clin Chem Clin Biochem, 31: 639 - 644.

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ALVEOLAR-ARTERIAL OXYGEN DIFFERENCE AND RATIO IN VENTILATED NEONATES.

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Both the alveolar-arterial oxygen difference (AaDO2) and the arterial/alveolar ratio (a/AR) are widely used as indices of gas exchange, although data on their performance in neonates are lacking. This study was carried out to test 1) how stable these two indices are, and 2) how accurate is the prediction (based on a/AR) of changes in PaO2 when FiO2 is changed. 26 studies were done in 20 clinically stable ventilated neonates (median birth weight and gestational age: 1640 g and 30 weeks respectively). An arterial blood sample was taken from an indwelling catheter and AaDO2 and a/AR were calculated. The predicted PaO2 (based on a/AR) was compared with the actual PaO2 in a second sample obtained 26-80 minutes (median 40) after a change in FiO2 (mean 15%); AaDO2 and a/AR were calculated again.
Results: mean baseline AaDO2 was 30.7 kPa (range 7.1-58.1); mean a/AR was 0.29 (0.085-0.69). Changes in AaDO2 were highly correlated with changes in FiO2 (r=0.94, P<0.0001, slope = 0.56 kPa/percent FiO2). Changes in a/AR were slightly correlated with changes in FiO2 (r=0.366, P<0.1). The mean difference between predicted and measured values of PaO2 after changes in FiO2 was 0.14 kPa (SD 3.15), yielding 95% confidence limits of -6.02 to 6.32 kPa.
Conclusions: 1) AaDO2 is highly dependent on FiO2, and should not be used to quantify gas exchange; a/AR is also (though to a lesser degree) sensitive to changes in FiO2; 2) the prediction of PaO2 based on a/AR calculation is accurate on average, but in individual cases the confidence limits are wide.

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BISFERIENS PRESSURE PEAKS IN THE NEONATAL RADIAL ARTERY WAVE AS A SIGN OF PATENT DUCTUS ARTERIOSUS (PDA).

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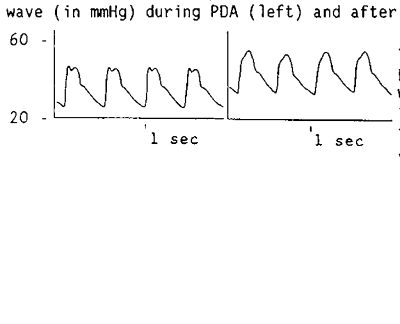
Previously, we found evidence that radial artery pressure wave forms in neonates resemble aortic pressure wave forms in adults. Therefore, it can be expected that the contour of the radial artery wave in infants provides information on central hemodynamics, such as existence of PDA. Using a high-fidelity catheter-manometer system (natural freq. 95 Hz, damping coefficient 0.15), we studied radial artery pressure wave forms in 24 critically ill neonates who suffered from PDA with left-to-right shunt (birthweight 1780 ± 880 gm, gestational age 31.3 ± 3.9 w). 23 infants showed a bisferiens systolic pressure wave. In 14 of them, pressure was measured again after ductal closure (as confirmed echocardiographically): bisferiens pressure peaks had disappeared in 13 of 14 infants. The figure below shows a representative radial artery wave (in mmHg) during PDA (left) and after ductal closure (right).



In sum, we found evidence that bisferiens pressure peaks in the radial artery wave are a sign of PDA. Further research is recommended to establish the mechanism and the diagnostic value.