

## BODY COMPOSITION – ENERGY EXPENDITURE

### Validation of dual, X-ray absorptiometry (DXA) for body composition assessment in piglets and in term human neonates.

JC Picaud, J Rigo, K Nyamugabo, J Milet, J Senterre (*Neonatal Unit, CHR de la Citadelle, université de Liège, Belgium*)

The reproducibility, accuracy and precision of DXA (Hologic QDR 2000, INFANT whole body software 5.64, 1993) was assessed by scanning 13 piglets (1 471 to 5 507 g) in triplicate. In four, the fat content (FC) was increased with porcine lard added around the abdomen allowing 17 additional measurements. DXA estimates of body weight (BW), bone mineral content (BMC) and FC were compared, respectively, with BW measured by electronic scale and with chemical analysis of piglets after complete homogenization of the whole carcass. FC was determined by gravimetric method after fat extraction and calcium content was determined by atomic absorptiometry. The reproducibility of DXA measurements was 0.09% for BW, 1.95% for BMC and 5.35% for FC; DXA estimates for BW, BMC and FC were significantly correlated with scale BW ( $r = 0.999$ ), chemical calcium ( $r = 0.992$ ) and chemical fat ( $r = 0.971$ ). Regression analysis showed that BW was accurately measured, but FC was overestimated (+ 11%) by DXA. From these results, conversion formulas were calculated to express DXA accuracy as a dispersion of DXA values below and above the reference values; it was called *precision* and was expressed as the mean difference in reference percentage between the converted DXA value and the reference value. The DXA precision was excellent for BW and BMC as the mean difference ( $\pm 1$  SD) was 0.01 ( $\pm 0.23$ )% and 0.05 ( $\pm 4.44$ )%, respectively. For FC, this difference was 22.11 ( $\pm 90.91$ )%. For measurements ( $n = 22$ ) performed in the piglets

with more than 250 g FC (which is the case in most human neonates weighing more than 2 000 g), the difference between DXA FC and chemical FC was reduced to 1.54 ( $\pm 8.85$ )%. Thirty appropriate for gestational age term human neonates (BW: 3 065  $\pm$  239 g) were scanned during the first week of life. BMC and FC were, respectively, 54  $\pm$  6 g HAP and 470  $\pm$  92 g, which corresponded to 26.4  $\pm$  2.6 g of calcium and 427  $\pm$  82 g of fat. These results were close to the reference values previously determined by chemical analysis in liveborn and stillborn infants. This study suggested that DXA is accurate and reliable for the measurement of calcium and fat contents in human neonates. Further refinements would be beneficial for determining the fat content in infants weighing less than 2 000 g.

### Low cost measurement of body composition with oxygen-18 enriched water.

P Ritz<sup>1</sup>, C Vache<sup>1</sup>, P Gachon<sup>1</sup>, M Ferry<sup>2</sup>, B Beaufriere<sup>1</sup> (<sup>1</sup> *Laboratoire de nutrition humaine, CRNH-Auvergne, Clermont-Ferrand*; <sup>2</sup> *Service de gériatrie, hôpital de Valence, Valence, France*)

Total body water (TBW) and body composition are important parameters of nutrition status in various clinical situations. The most direct and precise measurement of TBW involves labeling the subject with <sup>2</sup>H and/or <sup>18</sup>O enriched water. Whereas <sup>2</sup>H<sub>2</sub>O is cheap, <sup>2</sup>H measurements in biological fluids are technically difficult. On the other hand, <sup>18</sup>O measurements are very easy to do but the cost of regular (10%) <sup>18</sup>O-enriched water prohibits its widespread use in the assessment of body composition. Water drawn at the early steps of the distillation process is proportionally much cheaper than 10% water.

The aim of this study is to demonstrate that 2% <sup>18</sup>O-enriched water can be used for measuring TBW at low cost (ca 25 ECU or 150 FF per dose per subject). Plasma,

saliva and urine samples were collected before and 4, 5, 6, 7 and 8 h after labeling 41 healthy volunteers (aged  $67.5 \pm 5.1$  years, mean  $\pm$  SD; 20 women, 21 men). The dose of 2%  $^{18}\text{O}$  water was designed to increase the enrichment of TBW by 38 ppm above natural abundance. Eight of the volunteers also had a determination of TBW using 10%  $^{18}\text{O}$  water (enrichment of TBW increased by 307 ppm). Isotopic enrichments were measured by gas-chromatography isotope ratio mass spectrometry.

TBW (in % of body weight) did not differ whether 2 or 10% water was used (mean difference  $0.88 \pm 1.84\%$ ,  $P = 0.22$ ). An isotopic plateau was reached at hour 4 and lasted till the hour 8. The plateau value did not differ significantly between the three types of samples except for urine samples at hour 4; plasma  $2\ 037.7 \pm 4.3$ , urine  $2\ 037.7 \pm 4.0$ , urine  $2\ 036.4 \pm 5.1$  ppm, P vs U and S vs U:  $P < 0.01$ . TBW calculated from the enrichment at hour 5 ( $34.94 \pm 6.8$  kg) did not differ from that calculated from the plateau value ( $34.98 \pm 6.80$  kg,  $P = \text{NS}$ ).

In this group of elderly patients, TBW was  $49.1 \pm 5.7\%$  and fat mass was  $32.9 \pm 7.8\%$  of body weight. Fat mass differed with gender (men  $27.5 \pm 5.7$ , women  $38.5 \pm 5.2\%$ ,  $P < 0.0001$ ).

In conclusion, TBW and body composition can be accurately and precisely measured, at a low cost, with low enriched  $^{18}\text{O}$  labeled water. Collection of two samples of either urine or saliva made the method truly noninvasive. The present study confirmed body composition changes with age.

**Influence of nutritional status on diet-induced thermogenesis in cold acclimated rats.** R Bertin, F De Marco, R Portet (*Ephe, 105, boulevard Raspail, 75006 Paris, France*)

The experiments were performed on 7-week-old Sprague-Dawley rats which were

acclimated for 3 weeks either at  $28\ ^\circ\text{C}$  (thermoneutrality) or  $5\ ^\circ\text{C}$ . The animals were fed ad libitum (N group) or fasted for 18 h (J group) or fasted then refed for one and a half hours (RN group). They were given water and a commercial diet (UAR A03), and had light from 0700 to 1900 hours.

The indirect estimation of energy metabolism (EM) was performed on the three groups of rats, by continuous measurements of the  $\text{O}_2$  consumption and  $\text{CO}_2$  release at  $25\ ^\circ\text{C}$  by using an open circuit respirometer at the end of the feeding, fasting or refeeding periods.

The animal's capacity for nonshivering thermogenesis (NST) was estimated by the increase in oxygen consumption after ip injection of norepinephrine (NA) ( $400\ \mu\text{g}/\text{kg}$ ) and the duration of NA action (time between the onset of the increase and the return to the basal level).

Moreover, the levels and turnover rates of NA and the levels of serotonin (5HT) were measured in the interscapular brown adipose tissue (IBAT).

The resting metabolism was significantly higher in the  $5\ ^\circ\text{C}$  rats (N, J and RN groups) than in the three corresponding  $28\ ^\circ\text{C}$  groups. In these latter rats, no effect of fasting was observed, but, in the RN group, there was a significant increase ( $P < 0.05$ ) in EM. In the  $5\ ^\circ\text{C}$  fasted group, compared to the fed group, there was a substantial decrease (20%) in EM. In refed rats a large diet-induced thermogenesis (DIT) was observed compared to fasted animals (30%:  $P < 0.001$ ). The NST ability was found to be greater in the  $5\ ^\circ\text{C}$  than in the  $28\ ^\circ\text{C}$  rats. In this latter group, the maximal response was decreased by fasting and it was not restored in RN rats as it occurred for the duration of NA action. In the  $5\ ^\circ\text{C}$  group, the maximal response was not decreased by fasting. This contrasted with the global effect which was restored in RN animals.