

The Effect of Obesity on the Stress Response: The Paradigm of Surgical Stress

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Background knowledge

The ability to respond to stress constitutes a defensive protective mechanism; both inadequate and excessive responses may prove detrimental.

Objective and hypothesis

To investigate the effect of increased body weight on the hormonal response to stress in children. Scheduled surgical procedures include two stressful parts, a psychological one (anticipation of operation) and a biological one (surgical stress per se) and were chosen as a study model.

Patients and Methods

30 children, scheduled for minor surgical procedures (hernia, orcheopexy) and well otherwise, were included in the study. Two groups were studied:

Obese (O) group: 15 children, aged 5±2yrs, BMI-z score: 9.5±1.9

Normal weight (N) group: 15 children, aged 4±2, BMI-z score: 1.7±1.5

Blood samples were obtained in four distinct time points (phases):

P1: Pre-surgery room, prior to any manipulation. Reflects the psychological component of stress: anticipation of the operation

P2: 10 min after anaesthesia induction, prior to start of surgery

P3: During surgery (10 min after first incision). Reflects the biological component of stress: surgical stress per se

P4: One hour after the end of surgery. Reflects the ability to recover from stressful events.

Results and Discussion

Results are depicted in **Figures 1 – 3**.

Prolactin levels are high at P1 in both groups and gradually decrease in the N group, whereas stay unchanged throughout in the O group. Prolactin levels are significantly higher ($p=0.006$) at P4 in the O group, reflecting defective recovery from stressful event (**Figure 1A**).

GH levels are significantly lower in the O than the N group at start (P1 and P2, $p=0.003$), reflecting inadequate response and do not differ at P4 (**Figure 1B**).

T4 levels are significantly lower in the O than the N group at P2 and P3 ($p<0.001$ and $p=0.002$, respectively) and seem to rise inadequately. (**Figure 2A**).

TSH levels are significantly lower in the O than in the N group at P2 and P3 ($p=0.05$). TSH response is inadequate and delayed in the O group. (**Figure 2B**).

Cortisol levels were significantly higher in the N compared to the O group at P1 and P2 ($p=0.002$ and $<<0.001$, respectively), reflecting inadequate response. Delayed cortisol response is observed in the O group since cortisol levels peak at P2 in the N group, whereas in the O group peak at P4 (**Figure 3A**).

ACTH levels do not differ between the N and O group, however, the **cortisol/ACTH ratio** is significantly lower in the O than in the N group ($p=0.01$) throughout sampling (**Figure 3B and 3C**).

Conclusions

Alterations in stress response due to increased adiposity in children has not previously been reported. It is of interest that obesity **seems to affect the response to all components of a stressful event** (psychological, biological and recovery). Interestingly, it is **not only the intensity but also the timing of the stress response** that is affected in obese children (i.e., delayed) but these effects do not follow a distinct pattern with respect to hormones studied herein.

Overall, timing and intensity of the endocrine stress response differs between obese and normal weight children. The biological mechanisms involved are not apparent but may reflect an insufficient response to environmental stressors in obese children.

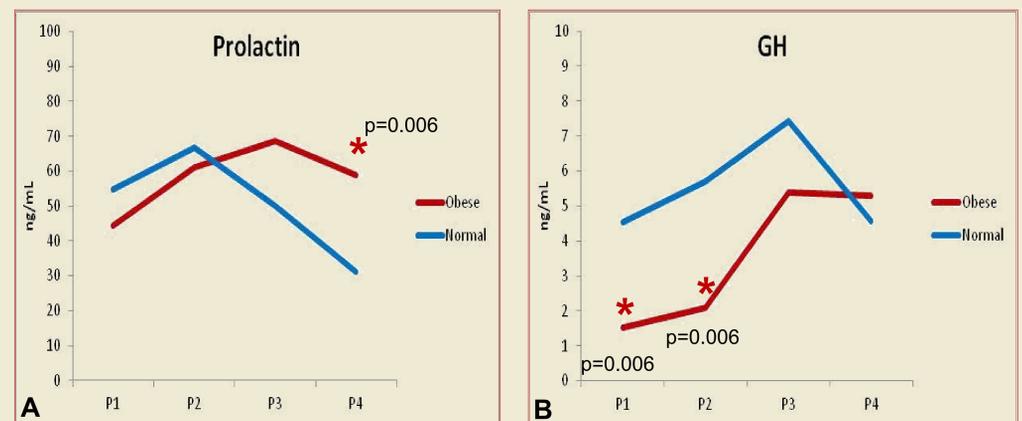


Figure 1: (A) Prolactin levels are high at P1, show a significant decrease between P1 and P4 in the N group and a significant increase between P1 and P4 in the O group. Prolactin levels are significantly different at P4 between the N and O group. (B) GH levels are significantly lower in the O compared to the N group at P1 and P2 and do not differ then on.

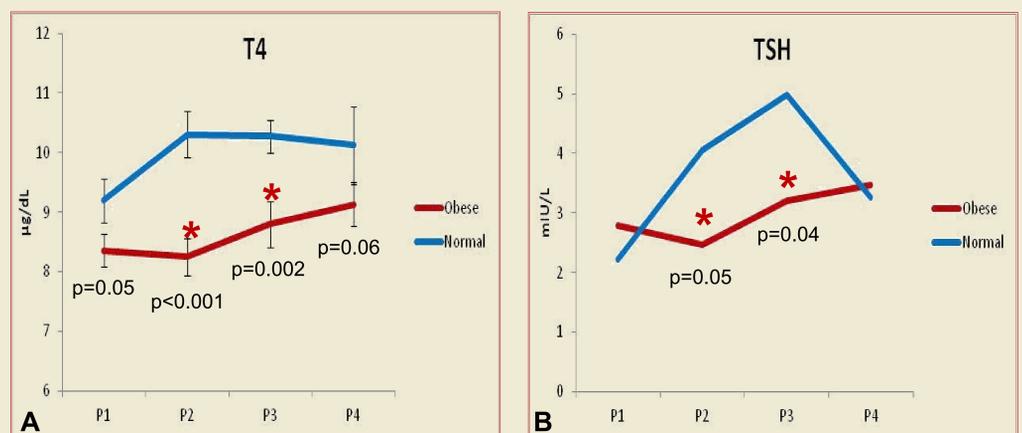


Figure 2: (A) T4 levels are significantly higher in the N than the O group at P2 and P3. (B) TSH levels peak inadequately and with delay in the O compared to the N group.

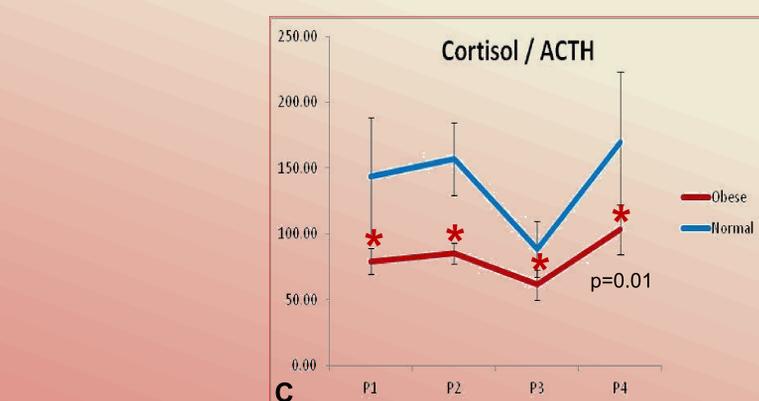
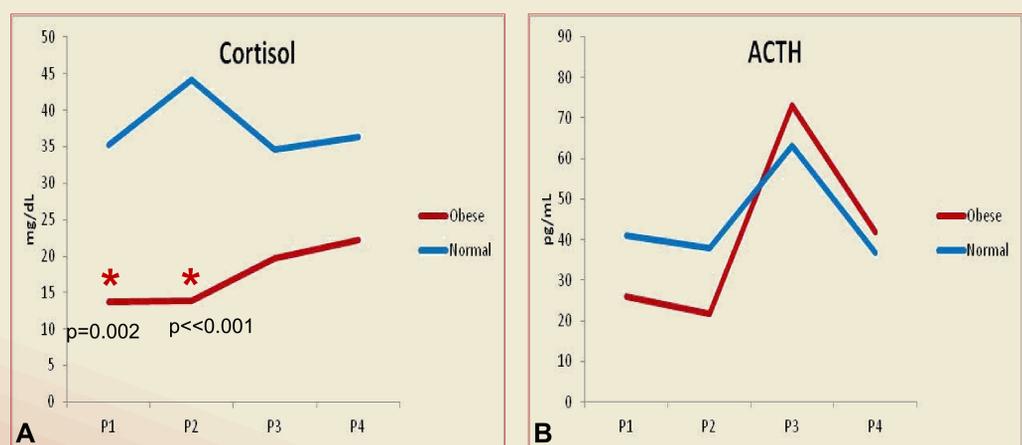


Figure 3: (A) Cortisol levels were significantly higher in the N compared to the O group at P1 and P2. Delayed cortisol response is observed in the O group since cortisol levels peak at P2 in the N group, whereas in the O group peak at P4. (B) ACTH levels do not differ between the N and O group. (C) cortisol/ACTH ratio is significantly lower in the O than in the N group ($p=0.01$) throughout sampling.