Changing of glucose absorption in the small intestine after various bariatric procedures

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Background

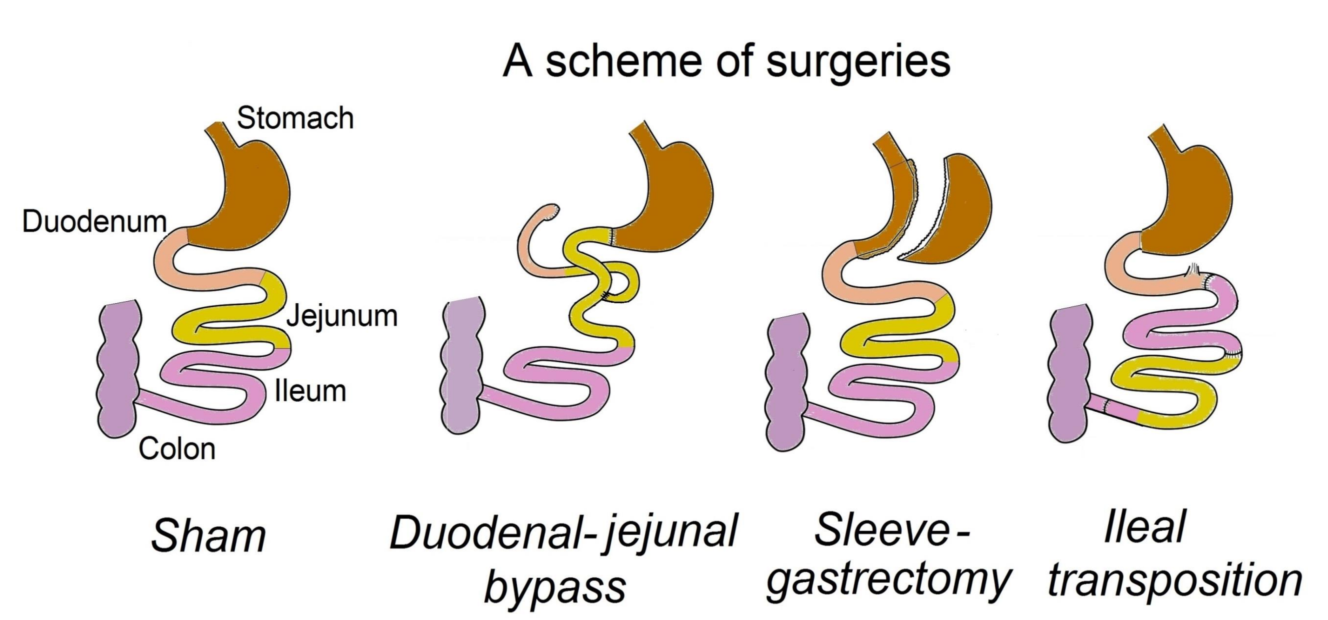
Diabetes mellitus type 2 is one of the most common diseases in the world. Bariatric surgery is widely used to reduce the adverse effects of type 2 diabetes. However, the effectiveness of bariatric surgery in patients with type 2 diabetes without the expressed obesity remains in question. To solve this problem, research is needed on animals to evaluate the effect of various bariatric procedures on carbohydrate metabolism in normal conditions and in experimental diabetes type 2.

Objectives

The aim of the study is to compare in the experiments on rats the influence of various bariatric procedures on body weight and glucose absorption in the small intestine, with estimation of different mechanisms of this process.

Materials & methods

The rats were subjected to the surgeries for duodenal-jejunal bypass, sleeve gastrectomy,, ileal transposition and sham operation (control).



Animal body weights and glucose absorption were measured 4 months after surgeries. Glucose absorption was assessed using a test, based on the rate of free consumption of glucose solution (200 g/L) by previously fasted rats. It has been earlier shown (Gruzdkov et al., 2015) that this rate closely corresponds to the rate of glucose absorption in the small intestine under normal conditions. Glucose transporters SGLT1 and GLUT2 in the enterocytes of jejunum and ileum were determined using immunocytochemistry and confocal microscopy. The glucose transporters levels in the apical membrane of the enterocytes were assessed semiquantitatively by measuring the fluorescence intensity of secondary antibodies in the region of this membrane with program *ImageJ.*

Results

4 months after the sleeve gastrectomy, glucose absorption in the small intestine was significantly lower, and the weight gain of the animals was also lower in comparison with the control (the sham operation). In the case of the ileal transposition, glucose absorption was significantly higher as compared with the control, whereas the weight gain in animals was, contrary, lower (fig. 1).

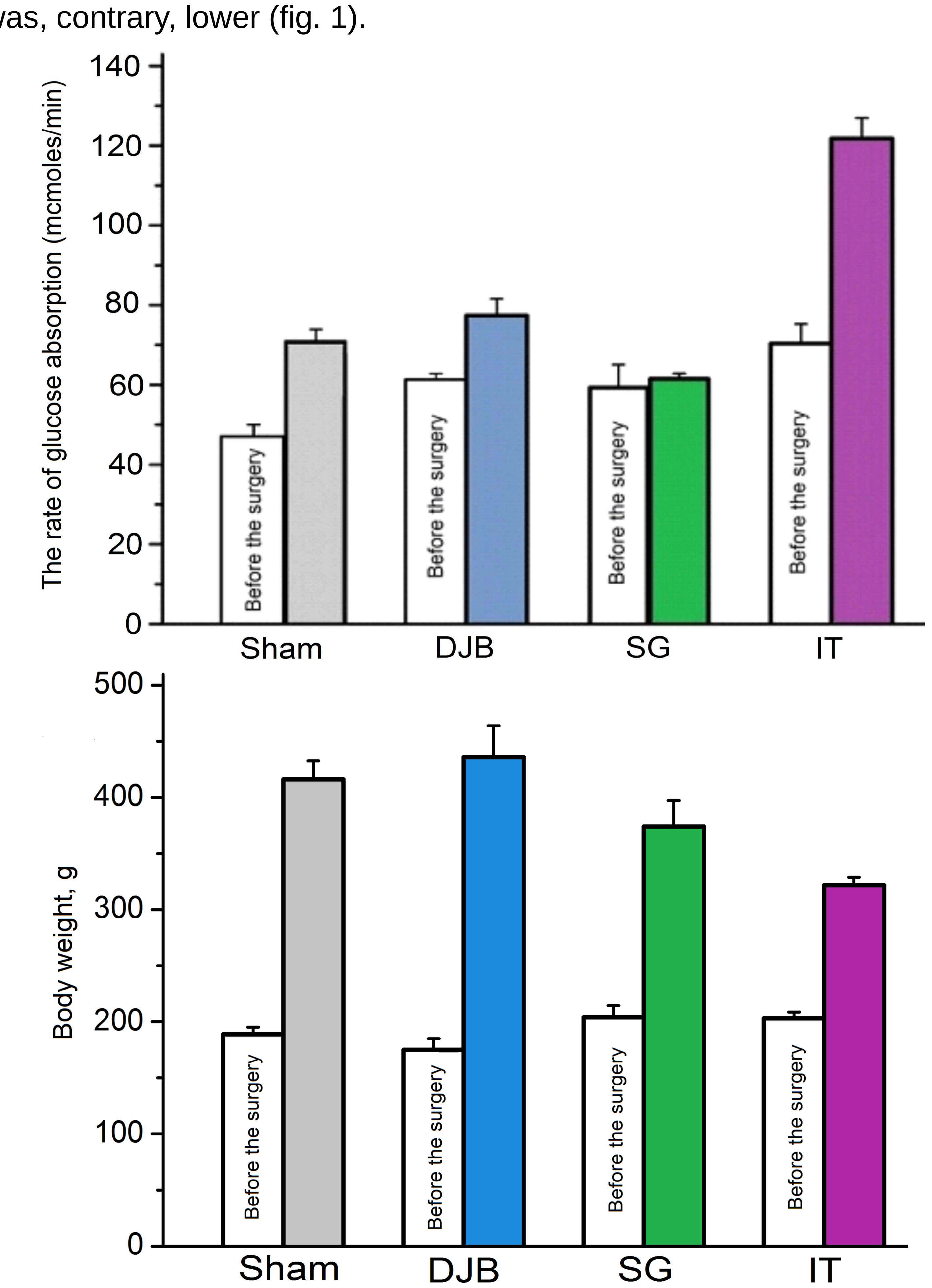


Figure 1. The rate of glucose absorption in the whole small intestine of previously fasted rats (upper part) and body weight of the rats (low part) before, and 4 months after various surgery operations. Sham – laparotomy; DJP – doudenal-jejunal bypass; SG - sleeve gastrectomy; IT – ileal transposition.

Results (cont.)

After the duodenal-jejunal bypass the intensity of immunofluorescence for SGLT1 in the apical membrane of the enterocytes from the ileum was 1.4 – fold higher, than that from the jejunum, and for GLUT2 it was, on the contrary, lower.

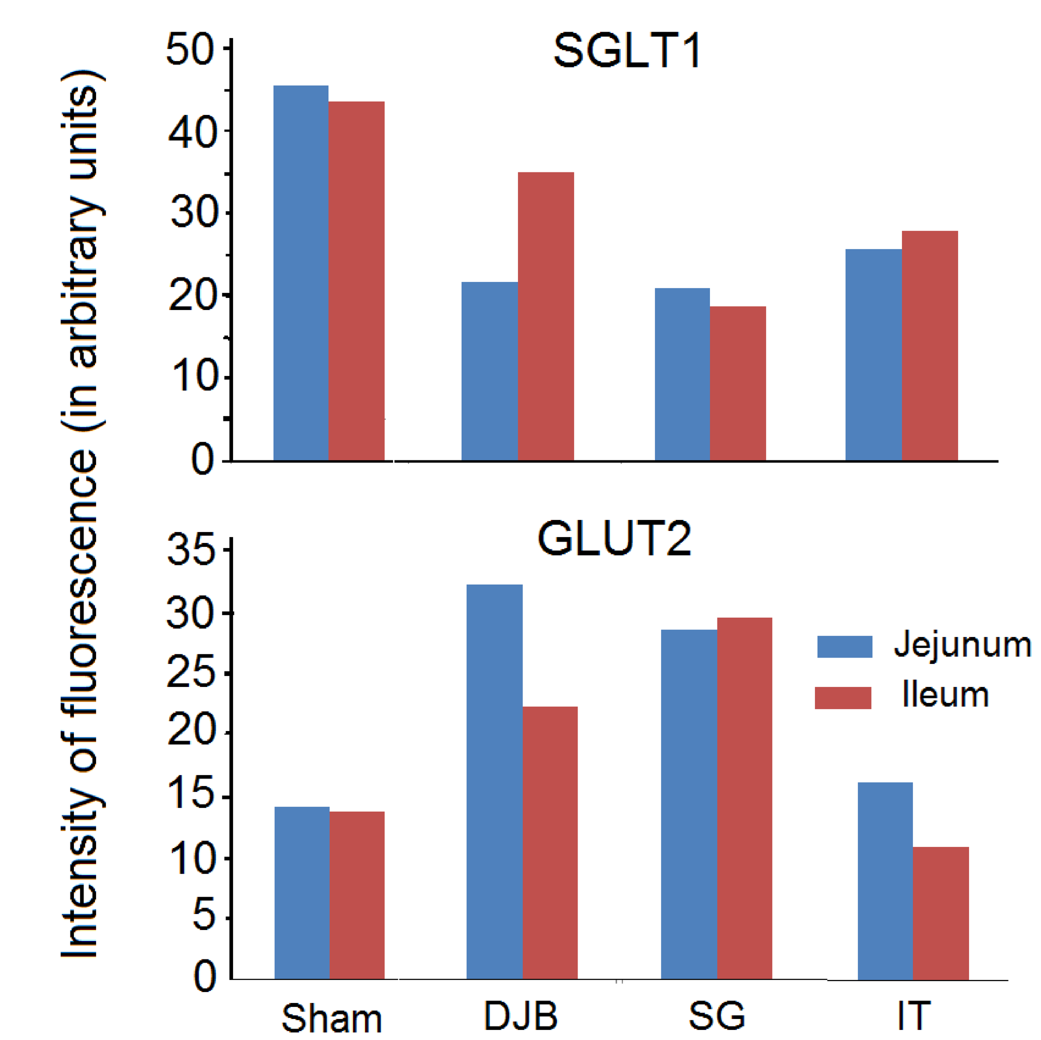


Figure 2. Quantification of glucose transporters in the enterocytes of the jejunum and ileum (using immunocytochemistry and confocal microscopy) after various surgery operations. Notations the same as in figures 1.

Conclusions

The changing of body weight and glucose absorption in the small intestine has specific features for different bariatric procedures.The data obtained are important to assess the impact of different bariatric procedures on carbohydrate metabolism and to develop the effective surgical approaches for the treatment of Type II diabetes in patients without the expressed obesity.

References

1. *Buchwald H. et al.. // JAMA. 2004, Vol. 292(14). P. 1724–1737.*
2. *Gruzdkov A.A. et al. // Russian J. Physiol. 2015. Vol. 101, No 6. P. 708–720.*
3. *Oh T.J. et al. // J. Diabetes Investig. 2016, Apr. Vol. 7, Suppl 1. P. 94-101.*
4. *Patriti A. et al.. // Surgery. –2007. – Vol. 142(1). – P. 74–85.*
5. *Schauer P.R. et al. // The New England journal of medicine. 2012. Vol. 366 (17). P. 1567–1576.*
6. Shimizu H. et al., // Journal of Obesity. 2012. Vol. 2012. Article ID 147256.

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