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Water, Sodium, Potassium, and D-Xylose Absorption in Canine Small Bowel Transplantation

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WITH many successful advances occurring in clinical small bowel transplantation (SBT), attention needs to be directed to the effect that denervation, preservation, and immunosuppression have on the function of the SBT. The goal of the present study was to determine the absorptive function of ileum and jejunum after SBT.

MATERIALS AND METHODS

Orthotopic SBT was performed in dogs according to the technique of Lillhey.[1] The intestinal absorption of water, sodium (Na), potassium (K), and D-xylose by the graft (jejunal and ileal segments) was evaluated at various time periods after allotransplantation (allotx) (n = 20; study days 3, 5, 7, and 10); allotx treated with FK 506, 0.1 to 0.4 mg/kg per day, IV (n = 10; study days 21, 25, and 35); autotransplantation (autotx) (n = 29; study days 7 and 14, 1 month, 3 months, 6 months, and 12 months); and in control nontransplanted (n = 6) animals. On the study day, jejunal and ileal segments (10 to 14 cm) were isolated under Nembutal anesthesia (25 mg/kg) and perfused with a solution containing Na (120 mmol/L), K (5 mmol/L), and xylose (100 μg/mL) in water (292 mOsm) at a constant rate of 1.17 mL/min over 45 minutes. The entire perfusate was collected over a 15-minute interval for a total of 45 minutes and measured for Na (flame photometry), K (flame photometry), xylose (spectrophotometry), and water (mass balance). At the end of infusion, tissue samples were taken for histology and the animals were killed. Net absorption of Na, K, and xylose was calculated as the difference between the amount infused and the amount recovered over 45 minutes per unit segment length. Water absorption was estimated as the difference in the volume of solution infused and the volume recovered per unit length of the segment. Statistical significance, at a $P < .05$, was determined using the Kruskal-Wallis ANOVA test.

RESULTS

The net absorption of xylose in control dogs was significantly different between the jejunum and the ileum (3.98 + 0.12 and 1.95 + 0.4 μg/cm per minute), but not for water (8.9 ± 4.4; 11.18 ± 1.4 μL/cm per minute), Na (0.1 ± 0.005; 0.127 ± 0.017 μEq/cm per minute), or K (0.01 ± 0.001; 0.011 ± 0.001 μEq/cm per minute). Electrolytes and xylose absorption was significantly lower during the immediate post-SBT, but return to normal values in about 35 days in autotx and in 3 months in allotx dogs treated with FK 506. Maximum water absorption was observed after 35 days in autotx ($P < .0003$), and on day 7 in the allotx group ($P < .0007$). Severe rejection, which occurred by day 10 in allotx not treated with FK 506, caused an increased permeability of xylose (5.33 ± 0.5; 6.1 ± 0.6 μg/cm per minute) and water (20.7 ± 0.9; 20.7 ± 1.05 μL/cm per minute) from the ileum and the jejunum, whereas Na (0.1 ± 0.01; 0.11 ± 0.01 μEq/cm per minute) and K (0.01 ± 0.0005; 0.01 ± 0.001 μEq/cm per minute) permeability was similar to control values.

DISCUSSION

Our study indicates that, in normal dogs, xylose is absorbed better in the jejunum than in the ileum, whereas such differences are not apparent with regards to water, Na, and K. The process of transplantation of the small bowel in itself is associated with alteration in the absorptive capacity of the small bowel for all the markers tested in allotx and autotx dogs. Our results are consistent with the reports of Sarr et al[2,3] and Kimura et al,[4] who showed that complete extrinsic denervation significantly alters the net absorption of water and Na in dogs and rats, respectively. Absorption of all the markers tested improved with time after transplantation in autotx dogs as well as in allotx dogs treated with FK 506, except for the secretory pattern observed transiently for water around week 3. In contrast, Watson[5] observed a decrease in net absorption of water and electrolytes with time in a rat model of jejunal transplantation. Our results indicate that absorption of xylose and water may not be useful as an indicator of an early graft rejection in this model. The increased xylose uptake during rejection is most probably related to the physical disruption of the mucosal side of the membrane. Lack of any relationship between D-xylose absorption and extensive graft rejection or GVHD have previously been documented in pigs[6] and in the nonhuman primate.[7]

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