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IN VIVO CHARACTERISATION OF THE GRASPER-INSTRUMENT INTERFACE IN LAPAROSCOPIC SURGERY

Introduction

Laparoscopic graspers cause trauma, and even perforation, of the bowel, but a comprehensive analysis of their effect on normal bowel has not been undertaken. This study aimed to analyze the forces involved in bowel grasping and the resulting histological damage.

Methods

Characterization was performed in a pig model, using: 1. an instrumented laparoscopic grasper to quantify the range of forces to successfully grasp and hold colon, 2. H&E histochemistry of tissue subjected to 10N, 20N, 40N, 50N, and 70N to detect changes in structural architecture. Forces were applied for 5, 30 and 60 seconds. The area of the circular and longitudinal muscle of a grasped sample was compared to control, ungrasped samples.

Results

The mean maximum force to grasp colon was 59N (43-75.5). The root mean squared force, reflecting force relaxation, was 24.6N. Significant differences in the longitudinal ($P=0.0001$) and circular ($p=0.0001$) muscle were found between the grasped and control samples for 70N force at 30 seconds. Under other conditions, there was a non-significant reduction in the area of the grasped section as compared to controls.

Conclusions

We have characterized the grasping force needed to hold colon. We have shown that grasping forces, equivalent to those used in laparoscopic surgery, result in histological injury to the muscle wall of the bowel and defined an upper limit for significant tissue injury. This is the first step in developing the next generation of atraumatic laparoscopic instruments.