Development of a murine colonoscopic polypectomy model (with videos)

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Background and Aims: Colonoscopy provides a means for screening and removal of colon adenomas, preventing such lesions from progressing to late-stage carcinoma. No preclinical model currently exists that closely parallels the clinical scenario with respect to polyp resection and recovery after endoscopy.

Methods: When we used the polyposis in rat colon (Pirc) model, a new polypectomy methodology was developed. A novel PLC classification system (polyp number/location/clockwise orientation) also was devised in order to accurately and reproducibly specify the location of each lesion within the colon.

Results: One week after surgery, injuries to the polypectomy site were confined to the submucosa, indicating that little or no damage occurred to the inner muscle layer of the colon. Polypectomy sites occasionally continued to show ulcer formation, whereas others exhibited tissue regeneration. A pilot study (n = 6 animals), involving a total of 37 polypectomies, confirmed that the new methodology could be applied by using either air insufflation or water-assisted techniques, with either hot or cold snare. As a general observation, polyps tended to be more fully distended and less flattened against the colon mucosa by using the water-assisted protocol, increasing the technical ease of ensnaring and resecting lesions. The PLC system proved to be straightforward and facilitated longitudinal studies by allowing the investigator to track each polypectomy site on repeated examination.

Conclusions: The Pirc model was ideally suited to colonoscopy with polypectomy. Because the main cause of morbidity in the Pirc model is blockage of the colon, polypectomy can be used as a preventive strategy and will likely facilitate long-term investigations of single agent and combination therapies with potential direct clinical relevance.

Colonoscopy provides the best current approach for screening and removal of colon adenomas.[1] Colonoscopies traditionally have been performed with air insufflation, which provides at least a 95% cecal intubation success rate.[2] Water-assisted colonoscopy recently has been discussed as an improved approach,[3] requiring less sedation.[4-9] An increase in the proportion of colonoscopy examinations performed with the patient under sedation[10]

Abbreviations: Pirc, polyposis in rat colon; PLC, polyp number/location/clockwise orientation.

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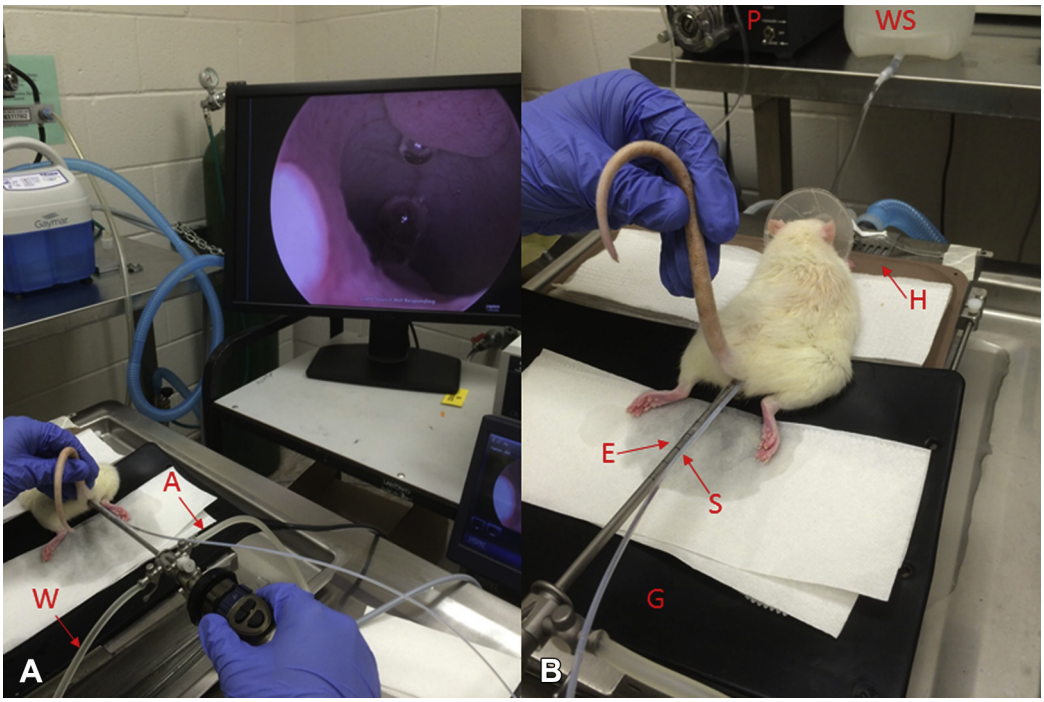

Figure 1. A, View of water-assisted colonoscopy in polyposis in a rat colon (*Pirc*) model, showing water port (*W*) and air port (*A*), and supply lines connected to a T junction. **B,** Pirc animal placed on a waterproof heating pad (*H*) showing the position of the examination sheath (*E*), snare tube (*S*), and grounding for electrocautery (*G*) as well as the peristaltic pump (*P*) and water source (*WS*).

suggests that further work is needed to validate the respective procedures.[11]

We developed a preclinical methodology that parallels the clinical scenario for colonoscopy with polyp resection. The polyposis in rat colon (Pirc) model was chosen based on several favorable features, including the presence of a significant colon tumor burden.[12] A pilot study examined the feasibility of using air insufflation and water-assisted techniques, with hot or cold snare, as described in the following.

METHODS

Animals

A 9-month time-point arbitrarily was chosen in the Pirc model. Given the importance of adequate bowel preparation,[13,14] rats were fasted for 24 hours but had free access to water. On the rare occasion of incomplete bowel preparation, an enema of pre-warmed water was applied with a Pasteur pipette.

System

The basic platform (Fig. 1) included a microendoscope (Hopkins forward-oblique, 30°, 2.7 mm diameter, 18 cm length, Karl Storz, Goleta, Calif), examination sheath with 2 ports (14.5F, 15 cm working length, working channel 5F, dual stopcocks, Karl Storz), camera capture system (Image SPIES, Karl Storz), and light source (Cold Light Fountain Power LED 175 SCB, Karl Storz). For air insufflation, an air pump (Petco Aquarium Air Pump, Houston, Tex) was connected to one port of the examination sheath (Fig. 1), with continuous air flow throughout the procedure.

For water-assisted colonoscopy, a peristaltic pump (3A, 115VAC, Celsep, Brinkmann Instruments, NY) provided pre-warmed water from the water source (WS, Fig. 1). Water released during the procedure was collected in a stainless tray placed under the procedure platform (Fig. 1). To avoid hypothermia, the animal was placed on a water-proof heating pad (K&H Pet Products, Colorado Springs, Colo). An insulating mat also was used for grounding during electrocautery (Fig. 1). Electrocautery was maintained between 5 and 15 W to avoid possible transmural necrosis and microperforation.

Polypectomy

A rigid colonoscope was inserted with an attached snare tube (Fig. 1B), allowing the first 10 cm of the colon to be visualized. In addition to the cold snare, hot snare was facilitated by linking the 2.4-mm snare (Karl Storz) to an electrocautery system (Autocon II, Karl Storz). After reaching the most proximal region of the colon, gradual withdrawal of the colonoscope allowed for sequential visualization and resection of polyps. By switching the snare position relative to the colonoscope and repeating the procedure on the same animal, most or all of the polyps were amenable to resection. During polypectomy under air, the water port was switched off at the T-junction (Fig. 1A), and as one