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GI Endoscopy Training: Validation of a Computer-Based Endoscopy Simulator

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Background: Conventional endoscopy training allows trainee access to real patients under supervision. This method may decrease diagnostic accuracy and increase patient discomfort, procedure-related morbidity and mortality. Computer-based endoscopy simulation permits more standardized acquisition and evaluation of skills. Aim: To establish construct validity of a computer-based endoscopy simulator by determining whether it differentiates novices from experienced endoscopists. Methods: An expert group comprised 4 experienced gastroenterologists, each having performed over 1000 colonoscopies. A novice group comprised a cohort of 30 first-year Canadian GI trainees (< 10 colonoscopies each) attending a 2-day endoscopy course hosted by McMaster University in July 2006. All participants received identical pretest instruction, and were asked to undertake the same colonoscopy simulation on the GI Mentor II VR simulator (Simbionix, USA, Cleveland, OH), with a redundant sigmoid and transverse colon but no significant pathology other than melanosis coli. Endoscopic skills were assessed by time to cecum, total procedure time, mucosa visualization (%), efficiency of examination, time with a clear view (%), number of times caused excessive local pressure, time patient was in pain (%), total time with loop formation, number of times a 3-D map was used, and number of times with lost view. Differences in mean scores among the 2 groups were assessed by independent sample t-tests. P-values were two-tailed, with statistical significance evaluated at 0.05 level. Results: Experts were more efficient than novices (91.3% vs 62.2%, $p < 0.05$). There was a significantly shorter procedure time (451.0s vs 886.4s, $p < 0.05$) and time to cecum (172.3s vs 531.6s, $p < 0.05$), larger proportion of time spent with a clear view of the lumen (90.5% vs 84.1%, $p < 0.05$), and less time with loop formation (1.8s vs 12.6s, $p = 0.01$) or excessive local pressure (0 vs 3.3, $p < 0.05$) in the hands of the experts. Percentage of mucosa visualized (85.3% vs 82.8%) and pain (0.25% vs 1.1%) were not statistically different. 3D map was used more often by novices than experts (17.2s vs 0 s, $p < 0.05$). Experts showed greater consistency in their performance than the novices, as demonstrated by a smaller SDs across all measures. Conclusion: The computer based endoscopy simulator can distinguish between expert and novice endoscopists, and thus has construct validity. Simulation may have a useful role in endoscopy training curricula as an objective assessment of skill acquisition. Future studies should validate the simulator as a predictor of performance in real procedures.

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Polyp Detection and Size Estimation At Capsule Endoscopy-Does Experience Improve Accuracy? A Prospective Animal-Model Study

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Introduction: Capsule endoscopy (CE) has a recognised role in small bowel surveillance for polyposis syndromes, and has proven to be more accurate than barium follow through in this setting. However, there may be a tendency to overestimate the number of polyps, and size estimation is confounded by fleeting views and lack of reference. We aimed to assess the accuracy of number and size estimation at capsule endoscopy using an animal-model, and made a comparison with level of experience. Method: We sewed artificial polyps of known size into a 6m length of porcine small bowel. An Olympus EndoCapsule was passed through the bowel using external finger-tip pressure for propulsion and to mimic peristalsis. The 90 min video was viewed using EndoCapsule Software. We enrolled 2 external capsule experts, 3 consultant gastroenterologists (2 with capsule experience), 7 gastroenterology trainees, 4 radiologists, 5 endoscopy nurses (2 with capsule experience) and 4 subjects with no medical training. Prior capsule and endoscopy experience was recorded. Logistic and linear regression analyses were performed. Results: Number of polyps: The experts identified the highest no. of polyps (92%) but also the most false positives (25.5). The consultants and registrars had similar levels of accuracy (90%, 88% respectively) but with fewer false positives for the consultants (1.3 vs 5.8). Radiologists, nurses and the non-medicals had similar accuracy (78%, 82%, 82%), but the radiologists had fewer false positives. Previous capsule experience reduced the chance of missing polyps (OR = 0.74, $p = 0.06$). Larger polyps were missed less often (OR: $\leq$9 mm = 1; 10-19 mm = 0.68; $\geq$20 mm = 0.58; $p = 0.71$). Size of polyps: Capsule experience did not improve accuracy of size estimation ($p = 0.59$). Compared with the experts, gastroenterology consultants, registrars and radiologists all achieved greater accuracy (OR = 0.61, 0.69 and 0.74 respectively, $p < 0.001$). Nurses and non-medicals were less accurate (OR = 1.18, 1.15 respectively, $p < 0.001$). Larger polyps were sized less accurately (OR: $\leq$9 mm = 1; 10-19 mm = 1.78; $\geq$20 mm = 2.60, $p < 0.001$). Conclusions: Capsule experience may improve the number of polyps identified but does not reduce false positives. It does not improve accuracy of size estimation. Gastroenterology consultants and registrars generally achieve good levels of accuracy even without prior capsule experience suggesting background training is important. Larger polyps are easier to identify but less easy to size. Since capsule experience does not necessarily equate to improved performance, either the technology must evolve or capsule endoscopy practitioners should undergo independent validation of performance.

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Electrical Characteristics of Various Submucosal Injection Fluids for Endoscopic Mucosal Resection

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Background: Various submucosal injection fluids are developed and introduced to clinical field. Electrical cutting and electrocoagulation are the main procedures performed during EMR. However, there has been few investigations about influences on these electrosurgical procedures by submucosal injection fluids, and electrical characteristics could be an important factor. We compared various submucosal injection fluids in respect of their retaining abilities, and verified their electrical implications related with the electrosurgery. Methods and Materials: 1) Porcine stomach was taken shortly after slaughter and pieces were cut out from the body portion in similar sizes and in full thickness. On a speed of 0.5 cc/second, 1 cc of the following fluids were injected submucosally: a) normal saline, b) 0.5% sodium hyaluronate, c) 0.25% sodium hyaluronate, d) hydroxypropyl methylcellulose, e) 10% glycerin, f) fibrinogen, g) 1% sodium alginate, and h) 2.5% sodium alginate. Photographs were taken to measure the heights of submucosal fluid cushion in 60 minutes. 2) An insulate-tipped knife (IT knife) was used as a working electrode, and electrical impedance was measured for eight fluids plus a reference solution (0.01N KCl) with a potentiostat electro-impedance spectrometry. Resistivity, specific characteristics of each injection fluids, was calculated by a simple equation using the measured impedance and cell constant (Kcell). Results: 1) Heights of eight submucosal fluid cushions were similar initially, and they decreased gradually in 60 minutes. However, normal saline and 10% glycerin showed greater height diminution than six other fluids, and these trends were statistically significant ($P < 0.05$). 2) Resistivity of eight fluids yielded to be in the range of 80 to 110 $\Omega \times$ cm, and the fibrinogen had a value of 309.7 $\Omega \times$ cm. Conclusions: 1) Normal saline and 10% glycerin showed faster decrease of height in a length of time, compared with six other fluids. This difference was statistically significant. 2) Resistivity of the eight fluids all differed, and fibrinogen had an especially high value. However, a handful of other variables may interact in determining the overall consequence of electrosurgery, and this may be clarified with further studies.

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A Model for Mortality-Morbidity Conferences in a Gastroenterology Training Program

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Mortality-Morbidity (M-M) conferences are an important component of quality improvement initiatives and education in endoscopy training programs. However, little has been written about the optimal manner to conduct these conferences. At the University of Colorado we have conducted monthly M-M conferences since July 1, 2001, in a format that has enhanced quality of performance and trainee education. Key components of the M-Ms are: 1) Three diverse institutions participate - University Hospital, Denver VA Medical Center, Denver Health Medical Center (a public hospital serving underserved persons); 2) all complications are reviewed briefly; 3) selected severe or especially instructive individual complications are discussed in detail; 4) gastroenterology trainees participate extensively in preparation and presentation of the conferences; 5) our complication rates for various procedures are compared regularly to corresponding rates cited in the literature; 6) topics concerning quality of care, e.g., colonoscopy preps, sedative medications, withholding of non-steroidal anti-inflammatory medications, biopsy techniques and patient consent for procedures are reviewed; and 7) minutes of each conference are distributed to service directors and risk-management offices of the hospitals. Results: Since the beginning of this M-M format, over 65,000 endoscopic procedures have been performed. The overall complication rate has been 0.75%, mainly associated with therapeutic procedures. Our complication rates for several procedures (colonoscopic perforation, post-polypectomy bleeding, liver biopsy, therapeutic ERCP) compare favorably with reported rates, but complications related to percutaneous endoscopic gastrostomy placement and colonic endomucosal resections were more frequent. Complication rates among the three institutions, despite differences in patient populations and faculty, have not been significantly different. The conferences have resulted in changes or recommendations made in 11 policies/procedure areas. Trainees and faculty consider the conference a useful educational exercise. Conclusions: The format of M-M we have initiated is an effective aid in monitoring quality of care, improving care, and education of trainees. We believe it can serve as a model for other academic institutions.