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ORIGINAL ARTICLE

Colonoscopy after spinal cord injury: a case–control study

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Design: An age- and gender-matched case–control study.
Objective: To compare colonoscopy after spinal cord injury (SCI) with the general population in terms of indications, bowel preparation, technical success and disease detection.
Setting: Victoria, Australia.
Methods: Consecutive SCI colonoscopies between January 1998 and February 2013 were compared with a randomly selected age- and gender-matched control group. Injury level, indication for procedure and demographics were collected. Outcome measures included quality of bowel preparation, completion rates, procedural duration and benign and malignant disease detection.
Results: A total of 440 colonoscopies were assessed, comprising 148 SCI patients and 292 age- and gender-matched controls. Both the groups were of similar age (54.7 years vs 54.5 years, $P=0.906$) and comprised predominantly males (87.1% vs 86.3%, $P=0.919$). SCI colonoscopies were more often performed to investigate abnormalities (85.1% vs 58.2%, $P<0.001$) than for screening or surveillance (18.2% vs 40.8%, $P<0.001$). Unsatisfactory bowel preparation was recorded more often in the SCI group (36.0% vs 13.0%, $P<0.001$) and completion rates were lower (75.7% vs 93.1%, $P<0.001$). Overall disease detection was lower in the SCI group (45.3% vs 59.6%, $P<0.006$). The polyp detection rate was lower for SCI (11.4% vs 25.3%, $P=0.001$). The rate of diagnosis of malignancy was equivalent (2.7% vs 3.0%, $P=0.904$).
Conclusion: SCI patients have the same risk of malignancy as the general population and are less likely to undergo screening colonoscopy. Colonoscopy is then limited by poor bowel preparation and lower completion rates with a subsequent lower polyp detection rate.
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INTRODUCTION

There is both an increasing prevalence and increasing average age of SCI patients.[1] Despite improvements in acute mortality, there is still a decreased life expectancy now most frequently attributed to cancer.[2] Colorectal cancer (CRC) screening in this group has received little attention despite reports of an at least equivalent cancer risk[3–5] and presentation with more advanced disease.[6]

Detection of occult neoplastic disease is difficult due to higher rates of gastrointestinal complaints[6,7] and the high frequency of PR bleeding should exclude SCI patients from faecal occult blood testing.[3]

Colonoscopy is challenging with difficulties in bowel preparation and low intubation rates despite multiday bowel preparation,[3,8,9] and studies assessing yield and safety of colonoscopy after SCI[3,8] have been limited by a small sample size or lack of a control group. We seek to highlight the difficulties with colonoscopy after SCI using a noninjured control group but to emphasise its importance by demonstrating the rates of benign and malignant diseases.

METHODS

An ICD-10 code search identified all patients with SCI who had colonoscopy or flexible sigmoidoscopy between January 1998 and February 2013. A prospectively entered endoscopic database was then accessed and computer-generated random numbers used to select an age- and gender-matched control group from the same period. Flexible sigmoidoscopies were then excluded if the original intent was for an abbreviated procedure. All procedures were included if the intent had been for a complete colonoscopy regardless of outcome.

SCI patients were admitted through the spinal unit for a standardised bowel preparation of twice daily administration of oral sodium phosphate over 3.5 days and rectal sodium phosphate the evening and morning prior to the procedure. The noninjured controls all had outpatient oral sodium phosphate or Glycoprep (Fresenius Kabi, Australia, NSW, Australia).

Similar to that described elsewhere,[3] the quality of bowel preparation was dichotomised to allow comparison as either 'satisfactory' to encompass the descriptors, 'good', 'adequate' and 'satisfactory' or 'unsatisfactory', to include 'poor', 'inadequate' and 'unsatisfactory'. A complete colonoscopy was indicated by caecal or terminal ileal intubation. Benign and malignant diagnoses were recorded. Immediate complications were sought on the endoscopic record. Ethics approval was granted by the regional ethics committee.

Statistics

An estimated sample size was calculated to give at least 80% power to detect a 20% difference in the quality of bowel preparation and completion rates, with an alpha error set at 0.05. Statistical analysis was performed using SigmaStat (Systat Software, San Jose, California). A two-tailed Student's *t*-test was used to compare age and gender. The quality of bowel preparation, technical success and disease detection rates were compared using chi-square with Yate's correction for continuity. Malignancy detection rate was compared using Fisher's Exact test.

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RESULTS

There were 440 procedures identified, 119 SCI persons had 148 colonoscopies compared with 292 controls. The SCI group had a mean age of 54.7 (s.d.13.005, s.e.m.1.080) and 129 (87.1%) were male. The controls had a mean age of 54.5 (s.d.13.5, s.e.m. 0.790) and 252 (86.3%) were male. Student's *t*-test confirmed the groups matched in age ($P=0.906$) and gender ($P=0.919$). Spinal injury neurological levels can be seen in Table 1.

The SCI group were more likely to undergo colonoscopy for a diagnostic indication (Table 2) than the controls (85.1% vs 58.2%, $P<0.001$) and less likely to have a screening or surveillance indication (18.2% vs 40.8%, $P<0.001$).

Bowel preparation was more likely to be unsatisfactory in the SCI group (36.0% vs 13.0%, $P<0.001$). The completion rate was lower in the SCI group (76% vs 93%, $P<0.001$). Incomplete colonoscopy was most commonly due to poor preparation and looping in both groups (Table 3).

There was no diagnosis recorded in 54.7% SCI procedures compared with 40.4% of controls ($P<0.006$). Haemorrhoids were the most common pathology in the SCI group (20.3% vs 9.6%, $P=0.003$) and diverticular disease the most common in the controls (4.1% vs 15.8%, $P<0.001$) (Table 4).

The polyp detection rate was lower in the SCI group (11.4% vs 25.3%, $P=0.001$) but there was no difference in malignancy (2.7% vs 3.0%, $P=0.907$).

The total duration of procedure and withdrawal times were absent from the majority of reports and not further analysed. There were no immediate complications recorded in either group.

Table 1 Levels of injury

	Total patients	*No. by injury type*
Cervical	70	Complete—28, incomplete—27, unknown—15
Thoracic	43	Complete—15, incomplete—9, unknown—19
Lumbar	6	Complete—2, incomplete—2, unknown—2
Sacral	—	—

Table 2 Indications for colonoscopy

Indication	*SCI*, n = *148*	*Controls*, n = *292*
Diagnostic	126	170
Anaemia	25	30
Overt bleeding	52	65
Diarrhoea/constipation	20	5
Altered bowel habit	8	32
Abnormal imaging	5	3
Abdominal distention	4	—
Abdominal pain	6	22
PR mucous	1	1
Haemorrhoids	1	—
Sepsis	1	—
Amoebiasis	1	3
Anal polyps	1	—
Diverticulitis follow-up	—	4
Liver abscess	—	1
Rectal mass	—	2
Weight loss	—	1
Ileus	—	1
Rectal pain	1	—
Screening/surveillance	27	119
Positive FOB	5	3
Family history	1	8
Screening	10	50
Surveillance		
Polyps	1	25
IBD	4	21
Cancer	5	6
Presurgical assessment	1	6

Abbreviations: FOB, faecal occult blood; IBD, inflammatory bowel disease; PR, peri-rectal; SCI, spinal cord injury.

Table 3 Caecal intubation rates and bowel preparation quality

	SCI, n = *148*	*Controls*, n = *292*	P-*value*
Age, years (s.e.m.)	54.7 (1.080)	54.54 (0.790)	0.906
Male, *n* (%)	129 (87.1)	252 (86.3)	0.919
Success			
Complete, *n* (%)	112 (75.7) Cervical: 71%; Thoracic: 81%; Lumbar: 100%	271 (93.1)	<0.001
Incomplete, n (%)	36 (24.3)	21 (7.2)	—
Poor prep	16	6	—
Looping	13	5	—
Redundant	3	2	—
Fixed/angulated	2	3	—
Clot	1	—	—
Obstructing tumour	—	5	—
Preparation quality			
Satisfactory, *n* (%)	94 (63.9)	254 (87.0)	<0.001
Unsatisfactory, *n* (%)	53 (36.0)	38 (13.0)	—
Not prepped	1	—	—

Abbreviation: SCI, spinal cord injury.

Table 4 Reported findings at colonoscopy

Findings	*Spinal (148)*	*Control (292)*	P-*value*
Normal	81 (54.7%)	118 (40.4%)	<0.006
Haemorrhoids	30	28	0.003
Polyp	17 (11.5%)	74 (25.3%)	0.001
Inflammation	11	19	0.425
Melanosis coli	9	3	0.006
Diverticular disease	6	46	<0.001
Malignancy	4	9	0.940
Anal fissure	3	—	—
Rectal prolapse	3	1	—
Megacolon	2	—	—
Ulcerative colitis/Crohn's	2	5	—
Anal ulcer	1	2	—
Angiodysplasia	—	3	—
Ulceration	—	1	—
Varices	—	1	—
Pin worms	—	1	—

DISCUSSION

The prevalence of SCI in Australia may increase to nearly 12 000 by the year 2021,[1] a trend partly due to a decrease in acute mortality.[2,10] An ageing background population and an independent increase in age at the time of injury account for a proportional increase in older patients with SCI.[1,10] An expected increase in the incidence of age-related conditions requires a focus on chronic and preventative healthcare.

Overall, cancer is the most common cause of late mortality after SCI.[2] In Australia, the general population has a 1 in 21 lifetime incidence of colorectal cancer[11] and while an early study suggested an increased risk of CRC in SCI,[12] our study supports the more recent notion of an equivalent cancer risk.[3–5] SCI patients have increased obesity and physical inactivity as CRC risk factors,[13] a tendency for a more advanced stage of malignancy at diagnosis[6] and an increased risk of complications in the treatment of established cancer,[14] thus further emphasising the need for screening and investigation of symptoms.

Multiple barriers limit the uptake of preventative healthcare measures in SCI patients.[13,15] Established CRC population screening guidelines are of limited utility given the high frequency of gastrointestinal complaints.[7] Clinical examination is challenging, resource-dependant, unreliable[16] and insufficient to exclude CRC. The occurrence of rectal bleeding in the majority should preclude the use of faecal occult blood test as a screening test.[3] Computed tomographic colonography still requires bowel preparation, is inaccurate for lesions <1 cm[11] and has not adequately been assessed in this population. Flexible sigmoidoscopy is arguably inadequate given high rates of proximal tumours.[3,12] Currently, only a minority of SCI patients undergo true screening colonoscopy[15] and is likely to be performed for a diagnostic purpose, that is, to investigate symptoms, anaemia or other abnormalities (Table 2).

Despite an equivalent risk of malignancy, we have reported a lower polyp detection rate after SCI than in age-matched controls (Table 4). In the absence of a plausible protective mechanism against neoplasia, we consider this a surrogate marker for poor bowel preparation in this group. A high-quality colonoscopy requires effective bowel preparation to decrease the rate of missed adenomas.[17,18] Indeed, a 40% polyp detection rate published elsewhere after excluding those with initially unsatisfactory preparations emphasises the equivalent prevalence of neoplasia, the importance of an adequate preparation and the means to facilitate a repeat procedure.[3] Poor bowel preparation was also the main reason for the more frequent failure to complete a colonoscopy (Table 3), and is known to increase the procedural difficulty and duration of procedure.[17] Of concern is the prediction that an increased adenoma miss rate portends an increase in interval and perhaps later stage cancers, but this has not yet been seen in our series.

The alterations in autonomic tone impair colonic transit[9,19] and make effective cleansing of the colon difficult.[8,20] To our knowledge, there is no published regime that can be considered satisfactory, and the use of a hyperosmolar agent alone is inadequate. Acknowledging concerns of acute phosphate nephropathy following oral sodium phosphate,[8] we are trialling a new regime based on two days of sodium picosulfate+magnesium+citrate (Fresenius Kabi) and a phosphate enema the morning of the procedure.

There is a paucity of literature addressing the prevalence of other benign diseases in SCI patients. Despite the prevalence of symptoms, we recorded a lower rate of benign diseases overall compared with controls. Two small comparative series had not previously demonstrated a difference between groups.[4,5] Haemorrhoids are much more common in SCI and the most frequent explanation for peri-rectal bleeding. Their occurrence is likely the consequence of altered anorectal tone permitting prolapse and/or the repeated trauma of digital stimulation to achieve evacuation.[7] An increased rate of melanosis coli is also predictable given the chronic laxative requirements in this population.[7,19] To our knowledge, this is the first series to demonstrate a lower rate of diverticular disease in SCI patients and is in contradistinction to previous reports of equivalent or increased prevalence[4,5] due to higher intracolonic pressures.[19]

The major limitations of this study relate to the retrospective nature of the review. Although the data was entered prospectively, there was no specific education to ensure consistency and comparison. Some duplicity in the indications reflects actual practice, where it is difficult to allocate strictly to either a screening or diagnostic category. Without prospective adherence to a prescribed bowel preparation quality classification system, we assigned binary variables as to whether or not bowel preparation could be considered satisfactory. A pitfall is that the bowel preparation regimes differed across the two groups, but any future comparisons should be compared within or across spinal cord injured groups, a task which will require collaboration with other spinal injury units. Although we recorded no immediate complications and there is a potential for missed or delayed complications, the procedure is still considered safe.[3]

In attempting to delineate the spectrum of benign disease, it became apparent that there may be a degree of underreporting of benign disease, and in particular, the incidence of haemorrhoids is likely even higher in the SCI group. This may account for the lower rate of benign diseases overall and the difference found in identifying diverticulosis and could be prospectively assessed.

Although difficulties with the quality of bowel preparation and completion rates have been described previously, screening and colonoscopy after SCI has still not garnered sufficient attention nor resources given the now known comparable CRC risk. The use of colonoscopy as a screening tool and to investigate symptoms must be emphasised. We have effectively demonstrated that there remain quantifiable discrepancies in terms of the quality of bowel preparation and polyp detection despite more intensive bowel preparation attempts and there needs urgent attention to prove a safe, efficient and effective bowel preparation regime for the SCI group as a whole, and perhaps in time a tailored regimen based on bowel dysmotility patterns associated with the level and type of neurological injury.

CONCLUSION

As the spinal cord injury population gets older, there needs to be attention to preventative healthcare strategies. SCI patients have a similar risk of colorectal cancer but are precluded from noninvasive screening due to the prevalence of symptoms and rectal bleeding. Given the limitations of clinical assessment, colonoscopy should be performed at regular intervals; however, whilst it can be considered safe, it is not without difficulties. There is no current optimal bowel preparation regimen, with subsequent lower completion and polyp detection rates. Colonoscopy should be encouraged but bowel preparation regimes need urgent attention to improve polyp detection rates and help prevent the incidence of colorectal cancer.

DATA ARCHIVING

There were no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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