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ORIGINAL ARTICLE

Musculoskeletal Pain Symptoms and Injuries Among Endoscopists Who Perform ERCP

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Abstract

Background and Aims The leaded protective gear worn, patient and endoscopist positioning, and longer average procedural time place endoscopists who perform endoscopic retrograde cholangiopancreatography (ERCP) at an increased risk of injuries as compared to other endoscopists. While multiple studies have investigated the prevalence of various pain symptoms and injuries among endoscopists, only one has been carried out in endoscopists who perform ERCP, and none have investigated potential predisposing risk factors. Our aim was thus to assess the prevalence of these pain symptoms, injuries, and potential risk factors.

Methods An anonymous electronic survey containing 23 questions was sent to 3276 gastroenterologists. Only providers that performed ERCPs were asked to respond.

Results A total of 203 surveys were completed. Of the 203 respondents, 91% reported a musculoskeletal pain symptom. The most prevalent pain symptoms were neck pain (24%) and lower back pain (17%). In total, 48% of respondents reported a musculoskeletal injury. In total, 32% attributed these injuries to performing ERCPs. The most prevalent musculoskeletal injuries were De Quervain's tenosynovitis (16%) and cervical radiculopathy (12%). Only 25% of participants had received any education/training on ergonomics in endoscopy.

Conclusions The majority of endoscopists who perform ERCPs suffer from a musculoskeletal pain symptom, and almost half report a musculoskeletal injury. Further investigation regarding risk factors and preventative strategies is warranted. This information can then be incorporated into ergonomics education which only a small proportion of advanced endoscopists report having received any training in.

Keywords Ergonomics · Endoscopic retrograde cholangiopancreatography · ERCP · Endoscopy · Repetitive stress injury · Occupational health

Background

Endoscopists frequently develop musculoskeletal pain and are at risk of a number of occupational injuries, such as De Quervain's tenosynovitis and carpal tunnel syndrome. Prior studies have reported the prevalence of musculoskeletal pain or injuries ranges from 29 to 89% among endoscopists in general [1, 2]. The types and frequency of pain symptoms include low back pain (6–27%), thumb pain (5–19%), shoulder pain (9–32%), elbow pain (8–15%), hand pain (9–17%), neck pain (9–28%), and hand numbness (12%) [1–7].

However, scant information is available regarding the development of musculoskeletal pain and injuries in advanced endoscopists performing endoscopic retrograde cholangiopancreatography (ERCP). Factors such as leaded protective gear, differences in patient and endoscopist

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positioning compared to standard endoscopic procedures, and longer procedural times likely place endoscopists who perform ERCPs at an increased risk of injuries in comparison with other endoscopists. A single study focused solely on endoscopists performing ERCP has been published previously–nearly two decades ago. In 2002, O'Sullivan and colleagues obtained examined survey responses from 114 endoscopists in Canada. Sixty-seven percent of respondents reported at least one musculoskeletal complaint, and 58% reported two or more complaints; 74% attributed their symptoms to endoscopy and/or ERCP, and 79% reported that their condition was aggravated by performing ERCP. The most frequently reported pain symptoms were back pain (57%), neck pain (46%), and hand pain (33%) [5].

Given the marked changes in the performance of ERCP in the last 20 years and the increasingly complex procedures, it is important to assess the current prevalence of musculoskeletal pain and injuries associated with ERCP and attempt to identify risk factors that may help direct future device and protective equipment development.

Methods

Physicians were identified using a pre-existing email list of American Society of Gastrointestinal Endoscopy members throughout the USA. An electronic survey containing 23 questions was sent to a pre-existing list of 3276 gastroenterologists who were members of ASGE. These survey questions were not validated. Only providers that performed ERCPs were asked to respond. Responses to the survey were kept anonymous.

The survey was designed to collect information about the respondents and their endoscopic practice, including variables considered potential factors in the development of musculoskeletal pain and injury, as well as their musculoskeletal pain symptoms and injuries. In addition, the survey questions of O'Sullivan and colleagues [5] were reviewed in the development of our survey questions. This draft survey was then reviewed and completed by three advanced endoscopists and one general gastroenterologist and revised based on their input.

The survey included a list of potential musculoskeletal pain symptoms or injuries. Participants could select only one musculoskeletal pain symptom and one musculoskeletal injury, thus enabling us to evaluate the predominant symptom and/or injury for each participant. They were also asked their sex, length of time performing ERCPs, glove size, average number of ERCPs performed yearly, average number of non-ERCP procedures performed yearly, need for treatment of symptoms and/or injuries, the presence of fluoroscopy tables with adjustable heights, the presence of anti-fatigue matting, whether they wore a one- or two-piece lead gown/apron, frequency of removal of lead gown/apron, time period performing ERCPs prior to symptom onset, predominant positioning of patients for ERCPs, the presence of adjustable monitor heights, frequency of assisting in lifting and moving of patients, and lead apron thickness. Respondents also were asked if they had received any education/training on ergonomics in endoscopy, and if so, whether those principles had been incorporated into their practice.

This was a cross-sectional, questionnaire-based descriptive study. The predefined analysis was to be a comparison of the proportion of respondents with pain in those with and without individual baseline characteristics and the proportion of respondents with injuries, with and without individual baseline characteristics. However, because almost all respondents reported pain, we were unable to meaningfully compare the proportion with pain related to baseline characteristics. We therefore performed a post hoc analysis using the outcome of musculoskeletal pain attributed to performing ERCPs in place of the overall pain outcome. In addition, due to the high rate of missing data regarding musculoskeletal injuries, we did not perform a comparison of the proportion with injuries related to baseline characteristics. Univariate analysis was performed using Chi-square test.

Results

A total of 203 (6.2%) gastroenterologists participated in the survey. A summary of demographic and procedure-related characteristics can be found in Table 1. Among the respondents, 184 (91%) reported a musculoskeletal pain symptom with 84 (46%) attributing this pain to performing ERCPs. Ninety-seven (48%) respondents reported a musculoskeletal injury, with 31 (32%) attributing these injuries to performing ERCPs. The most prevalent pain symptoms were neck pain ($n=49$, 24%) and lower back pain ($n=34$, 17%) (Fig. 1). The most prevalent musculoskeletal injuries were De Quervain's tenosynovitis ($n=32$, 16%) and cervical radiculopathy ($n=25$, 12%) (Fig. 2).

Among the respondents, only 73 (36%) used anti-fatigue matting, 83 (40%) wore two-piece lead gowns, and 147 (72%) were not aware of the thickness of their lead gown. Only 50 (25%) participants had received any education/training on ergonomics in endoscopy, and 145 (71%) stated they are interested in learning more about preventative strategies regarding ERCP-related injuries.

Table 2 presents the comparisons of pain attributed to performing ERCPs related to procedure-related characteristics. Respondents who performed fewer ERCPs tended to be less likely to have pain attributed to ERCP, especially when they performed ≤ 50 ERCPs: Only about one-quarter

Table 1 Demographic and procedure-related characteristics

Years performing ERCPs	0–5 years	6–10 years	11–15 years	16–20 years	> 20 years	No response				
	18	42	27	20	94	2				
Sex	Male	Female	No response							
	192	8	3							
Glove size	Small	Medium	Large	Extra large	No response					
	8	70	98	24	3					
Avg. number of ERCPs performed annually	0–50	51–100	101–200	201–500	> 500	No response				
	41	56	52	42	9	3				
Avg. number of non-ERCP endoscopic procedures performed annually	0–100	101–200	201–300	301–400	401–500	> 500	No response			
	4	6	2	12	10	168	1			
Pain symptoms	Neck pain	Lower back pain	Mid-/upper back pain	Shoulder pain	Elbow pain	Finger pain	Hand pain	Wrist pain	Heel pain	No response
	49	34	16	15	6	15	21	22	6	19
Injuries	Cervical radiculopathy	Lumbar radiculopathy	Ulnar nerve entrapment	Radial nerve entrapment	Carpal tunnel syndrome	De Quervain's tenosynovitis	No response			
	25	19	6	3	12	32	106			
Presence of fluoroscopy table with adjustable height	Yes	No	No response							
	151	50	2							
Presence of anti-fatigue matting	Yes	No	No response							
	73	127	3							
Type of lead gown/apron	One piece	Two piece	No response							
	118	82	3							
Frequency of lead gown/apron removal	Never	Sometimes but not daily	1 time/day	2–3 times/day	> 3 times/day (but not in between every case)	In between every case	No response			
	4	4	1	5	3	183	3			

Table 1 (continued)

Years performing ERCPs	0–5 years	6–10 years	11–15 years	16–20 years	> 20 years	No response	
Time period performing ERCPs prior to symptom onset	1–3 years	4–6 years	7–10 years	11–15 years	16–20 years	> 20 years	No response
	32	47	29	30	17	18	30
Patient positioning for ERCPs	Mostly supine	Mostly pone	No response				
	30	169	4				
Adjustable monitor heights	Yes	No	No response				
	152	49	2				
Frequency assisting in lifting/moving patients	Never	Sometimes but not daily	1 time/day	2–3 times/day	> 3 times/day (but not in between every case)	In between every case	No response
	19	109	10	21	17	23	4
Lead gown/apron thickness	0.25 mm	0.35 mm	0.5 mm	Unknown	No response		
	7	28	17	147	4		

Fig. 1 Pain symptoms

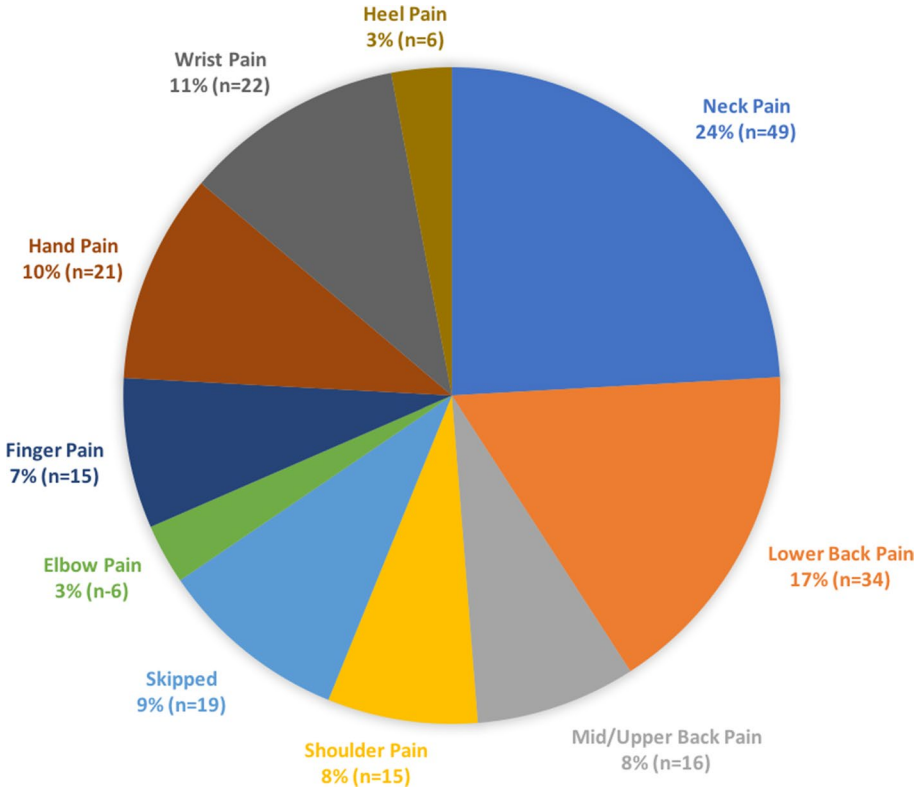
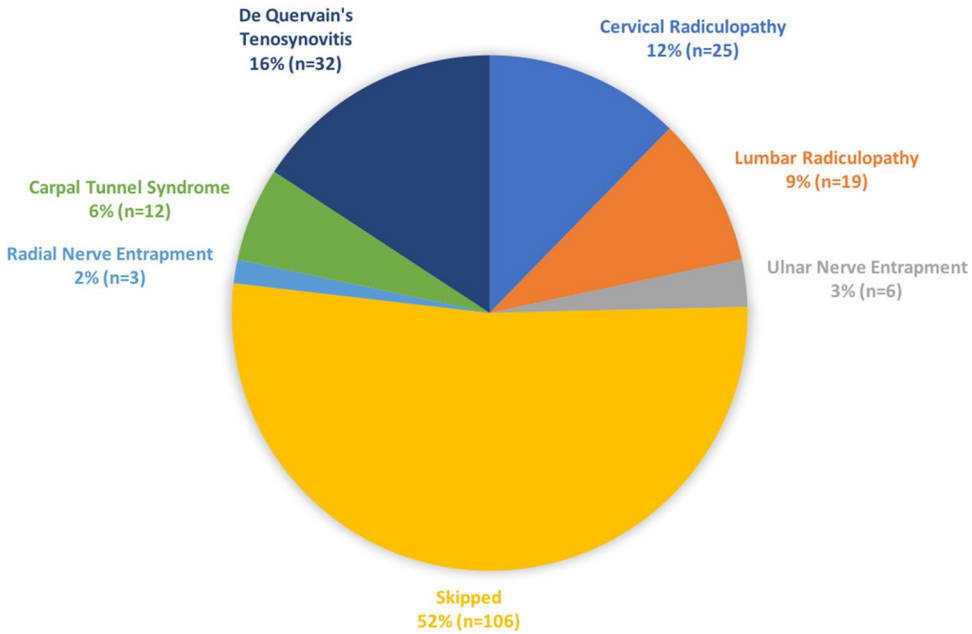


Fig. 2 Injuries



performing this number of ERCPs attributed pain to ERCPs, while just over half of respondents performing > 100 ERCPs per year attributed to ERCPs (Table 2).

Discussion

This survey of US endoscopists performing ERCPs found that approximately 90% suffer from a musculoskeletal pain symptom, with almost half attributing their pain to

Table 2 Pain symptoms attributed to performing ERCPs

Sex	Male	Female					*P* value
	84/186 (45%)	2/8 (25) %					0.305
Fluoroscopy tables with adjustable height	Present	Absent					
	67/144 (47%)	18/50 (36%)					0.196
Anti-fatigue matting	Present	Absent					
	27/70 (39%)	58/123 (47%)					0.248
Lead gowns worn	One piece	Two piece					
	46/114 (40%)	39/79 (49%)					0.215
Patient positioning	Supine	Prone					
	14/28 (50%)	71/164 (43%)					0.509
Adjustable monitor height	Present	Absent					
	61/147 (41%)	24/47 (51%)					0.25
Lead apron thickness	0.25 mm	0.35 mm	0.5 mm	Unknown			
	5/7 (71%)	15/27 (56%)	10/17 (59%)	84/192 (44%)			0.071
Lifting/moving patients	Never	Sometimes/not daily	Once daily	2–3 times daily	> 3 times/day (but not in between every case)	In between every case	
	9/18 (50%)	44/105 (42%)	2/10 (20%)	12/20 (60%)	6/16 (38%)	11/23 (48%)	0.395
Length of time performing ERCPs	0–5 years	6–10 years	11–15 years	16–20 years	> 20 years		
	9/17 (53%)	19/42 (45%)	13/26 (50%)	10/20 (50%)	34/88 (39%)		0.685
Number of ERCPs performed per year	0–50	51–100	101–200	201–500	>500		
	9/38 (24%)	21/55 (38%)	27/51 (53%)	23/41 (56%)	5/9 (56%)		0.017
Number of non-ERCP endoscopic procedures performed per year	0–100	101–200	201–300	301–400	401–500	> 500	
	1/4 (25%)	0/5 (0%)	1/2 (50%)	6/10 (60%)	5/10 (50%)	73/164 (45%)	0.302

performing ERCP. In addition, almost half of endoscopists performing ERCP have a musculoskeletal condition such as De Quervain's tenosynovitis or cervical radiculopathy. As might be expected, those respondents performing a greater number of ERCPs were more likely to report musculoskeletal pain they attributed to ERCPs. This relationship appeared to plateau at around 50% once an endoscopist exceeded 100 ERCPs annually, without further increase with increasing numbers of ERCPs performed.

The frequent reports of musculoskeletal pain symptoms and conditions support the need for improvements in education regarding ergonomic factors in the performance of ERCP. In addition, identification of modifiable risk factors is of importance to assist in the development of preventative strategies. We were unable to identify such factors, other than number of ERCPs performed. Further studies, including prospective assessments, are warranted to characterize the causes of musculoskeletal problems of endoscopists performing ERCPs.

We found that nearly three-quarters of endoscopists are interested in learning more about preventative strategies regarding ERCP-related injuries. As we acquire more knowledge of risk factors for musculoskeletal pain symptoms and injuries, it will help direct preventative measures. These preventative measures can then be used to formulate educational material for both endoscopists and trainees. It is important that this knowledge is introduced early in training as positional and technical habits develop quickly. Thus, our hope is that fellowship programs focus on critiquing of ergonomics as well as trainee competency.

Future studies should also investigate ergonomic measurements in endoscopists who perform ERCP. A study in which right-thumb pinch force and bilateral forearm muscle activity while performing colonoscopies were measured

found that the highest mean right-thumb peak pinch forces exceeded the injury threshold, and the activity of the left abductor pollicis longus, left extensor carpi radialis, and right extensor carpi radialis exceeded the American Conference of Industrial Hygienists (ACGIH) hand activity level (HAL) action limit [8]. It would be useful to perform similar measurements during ERCPs as this could also direct future device designs to limit forces sustained by advanced endoscopists.

One limitation of the study was the low survey response rate (6.2%). However, a low response rate was expected as this survey was distributed broadly to ASGE members, but only providers who performed ERCP were asked to respond. For future studies, having a database of only providers who perform ERCP would be invaluable as it would allow us to focus survey distribution to only eligible participants. Although this study is the largest ergonomics study to date focused on providers who perform ERCP, the sample size was still relatively small. Given the high prevalence of musculoskeletal pain symptoms, future studies will need to involve more participants in order to attain enough asymptomatic endoscopists for comparative analysis. Given this survey was focused on musculoskeletal pain symptoms and injuries, it is possible bias could have skewed the results as endoscopists with injuries and/or pain symptoms may have been more likely to participate in the survey. Another limitation of this study was that participants were only able to select one pain symptom and one musculoskeletal injury. Thus, despite the strikingly high prevalence of these two outcomes, the true prevalence is likely much higher. In addition, half of the respondents skipped the question regarding musculoskeletal injuries; because we did not have an option to enter other injuries, we cannot be sure if these individuals did or did not have other musculoskeletal injuries, thus limiting our assessment of total musculoskeletal conditions.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research ethics committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. For this type of study, formal consent is not required.

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