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Physician pain and discomfort during minimally invasive gynecologic cancer surgery

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Abstract

Objective—Despite increasing awareness of physical strain to surgeons associated with minimally invasive surgery (MIS), its use continues to expand. We sought to gather information from gynecologic oncologists regarding physical discomfort due to MIS.

Methods—Anonymous surveys were e-mailed to 1,279 Society of Gynecologic Oncology (SGO) members. Physical symptoms (numbness, pain, stiffness, and fatigue) and surgical and demographic factors were assessed. Univariate and multivariate analyses were performed to determine risk factors for physical symptoms.

Results—We analyzed responses of 350 SGO members who completed the survey and currently performed >50% of procedures robotically (n=122), laparoscopically (n=67), or abdominally (n=61). Sixty-one percent of members reported physical symptoms related to MIS. The rate of symptoms was higher in the robotic group (72%) than the laparoscopic (57%) or abdominal group (49%) (p=0.0052). Stiffness (p=0.0373) and fatigue (p=0.0125) were more common in the robotic group. Female sex (p<0.0001), higher caseload, (p=0.0007) and academic practice (p=0.0186)

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CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

were associated with increased symptoms. On multivariate analysis, robotic surgery (odds ratio [OR] 2.38, 95% CI 1.20-4.69) and female sex (OR 4.20, 95% CI 2.13-8.29) were significant predictors of symptoms. There was no correlation between seeking treatment and surgical modality (laparotomy 11%, robotic 20%, laparoscopy 25%, $p=0.12$).

Conclusions—Gynecologic oncologists report physical symptoms due to MIS at an alarming rate. Robotic surgery and female sex appear to be risk factors for physical discomfort. As we strive to improve patient outcomes and decrease patient morbidity with MIS, we must also work to improve the ergonomics of MIS for surgeons.

Keywords

laparoscopy; robotic surgery; laparo-endoscopic single-site surgery (LESS); pain; numbness; discomfort; fatigue

INTRODUCTION

Surgeon physical discomfort related to minimally invasive surgery may affect as many as 88% of gynecologists [1]. Across medical specialties, the strongest risk factor for physical symptoms from minimally invasive surgery has been higher case volume: an increase in physical symptoms was seen as the case load increased [3]. Within gynecology, physician pain and related symptoms have been found to be correlated with surgeon characteristics, including height, young age, female sex, and high body mass index [1]. Female sex has also been found to as much as double the risk of surgeon discomfort associated with minimally invasive surgery [2]. Much of the physical discomfort experienced by surgeons performing minimally invasive surgery has been attributed to ergonomic challenges faced in the operating room, such as challenges due to instrument design and room set-up [4]. Despite the increasing awareness of the physical strain associated with minimally invasive surgery, there has been continued expansion in its use with little attention to its toll on surgeons. This expansion of minimally invasive surgery is likely due to the increasing body of literature showing that it is associated with decreased patient morbidity, improved postoperative recovery, shorter hospital stay, and cosmetic advantages compared to open surgery without compromise of surgical outcome [6-9].

One of the potential advantages of robotic surgery cited early in the implementation of this technique was the potential for reducing physical discomfort for the surgeon. In a 2012 study, only 8% of surgeons who reported physical discomfort with surgical procedures attributed it to robotic surgery, whereas 55% of surgeons who reported physical discomfort attributed it to traditional laparoscopy [10]. However, a more recent study suggested serious deficiencies within robotic surgery in regards to ergonomics of upper body positioning that may pose a great risk for musculoskeletal injury in surgeons [11].

Because an increasing number of surgeons are considering their own comfort when choosing an operative modality, we sought to gather further information regarding physical discomfort due to minimally invasive surgery within the field of gynecologic oncology. Our aim was to improve understanding of the challenges surgeons currently face in hopes of highlighting areas for improvement.

METHODS

After obtaining approval from the Institutional Review Board of The University of Texas MD Anderson Cancer Center and the Society of Gynecologic Oncology, we mailed a survey about laparoscopic surgery to all 1,279 full and candidate members of the society. The questions were based on those in our previous surveys of 2003 and 2007 [12-14], with some modifications to obtain updated information. The modifications included a new section on surgeon symptoms of discomfort with questions taken from a previously published instrument [3]. Questions were aimed at correlating physical symptoms of discomfort (numbness, pain, stiffness, and fatigue) with demographic data and surgical approach (Table 1).

The survey was mailed in January 2012, and a follow-up reminder postcard was sent 1 week after the initial mailing. The survey was mailed again in February and April 2012. Respondents were given the option of replying via the internet; the cover letter included a link to an online survey instrument whereby responses could be submitted electronically. The paper surveys had control numbers for mailing purposes to ensure that no Society of Gynecologic Oncology member received a second survey if he or she had returned a completed survey between the time of the first and second mailings. All responses were anonymous as neither the online nor the paper copies of the surveys had names associated with the responses. The survey was estimated to take 8 minutes to complete.

Our primary aim was to determine if physical symptoms were associated with surgical modality. For the purpose of our study, the robotic group was defined as surgeons who performed >50% of all procedures robotically; the laparoscopic group was defined as surgeons who performed >50% of all procedures via traditional laparoscopy, laparo-endoscopic single-incision surgery, or a combination of the two; and the abdominal group was defined as surgeons who performed >50% of all procedures via an open approach. Our secondary aim was to evaluate relationships between physical discomfort and other potential risk factors.

Statistical analysis included tabulation of responses and the use of Fisher's exact test to test for association between responses to two questions of interest. Univariate logistic regression was used to estimate the strength of association between factors of interest and the presence of any symptoms of surgeon physical pain or discomfort. Multivariate logistic regression was then performed by first fitting a saturated model including those factors found to be statistically significant on univariate analysis and using backward elimination to remove factors from the model until all remaining factors were statistically significant. *P* values <0.05 were considered statistically significant.

RESULTS

Of the 1,279 members of the Society of Gynecologic Oncology who were sent surveys, 406 completed the survey, for an overall response rate of 32%. Our analysis is based on the 350 respondents (27%) who performed at least 50% of procedures with robotic surgery (n=122), with laparoscopic surgery (n=67), or with an open approach (n=61).

Physical Symptoms by Surgical Approach

Approximately 61% of surgeons reported physical discomfort that they attributed to minimally invasive surgery. Seventy-two percent of surgeons in the robotic group reported any symptoms, compared to 57% of surgeons in the laparoscopic group and 49% of those in the abdominal group ($p=0.005$) (Table 2). Stiffness and fatigue were reported at significantly higher rates in the robotic group than in the other two groups. Numbness and pain were also reported more often in the robotic group, but these differences were not significant.

Physical Symptoms by Sex and Age

Eighty-one percent of women compared with only 51% of men reported symptoms ($p<0.0001$) (Table 3). Women reported numbness, pain, stiffness, and fatigue at significantly higher rates than men. Younger surgeons were more likely than older surgeons to report symptoms in general ($p<0.0001$) and to report the specific symptoms of pain, stiffness, and fatigue (Table 4).

Physical Symptoms by Practice Characteristics and Training

Physicians practicing in an academic setting were more likely to report symptoms than were those practicing within a community hospital ($p=0.02$) (Table 5). Furthermore, surgeons who performed 6-10 minimally invasive procedures per month were more likely than those who performed 1-5 or >20 laparoscopic procedures per month to report symptoms (73% versus 45% and 52%, respectively; $p=0.0007$). No association was found between reported symptoms and years performing minimally invasive surgery, amount of laparoscopic training during fellowship, type of assistant, or rate of conversion of a minimally invasive approach to laparotomy.

Regression Analysis

On multivariable analysis, the use of the robot system (odds ratio [OR] 2.38) and female sex (OR 4.20) were the only variables that remained statistically significant for any symptom (Table 6). After controlling for other variables, surgeons who used laparoscopy for $>50\%$ of their cases were not more likely to report physical symptoms than were surgeons who performed open surgery (OR 1.29, 95% CI 0.62-2.71). In addition, age, case load, and practice type were not associated with the presence of surgery-related symptoms.

Treatment for Symptoms

Women and men sought treatment for symptoms at similar rates, with 24% of women seeking treatment compared to 18% of men ($p=0.19$). Furthermore, surgeons of all ages sought treatment at similar rates ($p=0.08$). Eleven percent of surgeons aged 30-40 years sought treatment, with 28% of surgeons aged 41-50 yrs., 20% aged 51-60 yrs., 19% aged 61-70 yrs., and 16% over 70 yrs. seeking treatment for physical symptoms. There was no correlation between seeking treatment and method of surgery (laparotomy 11%, robotic 20%, laparoscopy 25%, $p=0.12$), years performing laparoscopy (<1 yr. 0%, 1-5 yrs. 11%, 6-10 yrs. 20%, 11-15 yrs. 27%, >15 yrs. 23%, $p=0.34$), or type of assistant (fellow/resident -21%, general obstetrician - 20%, general surgeon - 27%, gynecologist oncologist - 21%, operating room staff 21%, p -value NS).

DISCUSSION

Our survey showed that 61% of gynecologic oncologists reported symptoms related to performing minimally invasive surgery. Perhaps the most interesting finding of our survey is that surgeons who performed the majority of surgeries robotically were more likely to report symptoms than were surgeons who performed the majority of surgeries laparoscopically or abdominally. Whereas the rate of surgeon fatigue was previously reported to be equal between robotic and laparoscopic surgery [15], our survey showed a significantly higher rate of fatigue in the robotic group. We also found higher rates of reported stiffness in the robotic group. Furthermore, although these differences were not statistically significant, surgeons in the robotic group also had higher rates of reported pain and numbness. Although this survey is unable to determine the reasons why surgeons who utilize the robotic platform report more adverse physical symptoms, it may be a result of increased neck and shoulder tension from assuming a prolonged, fixed posture at the console without breaks to stretch or change position, activities that naturally occur during open or laparoscopic cases. Recent expansion in the use of the robotic platform to include complex, lengthy procedures that were previously only performed via laparotomy may also contribute to increased physician discomfort.

Our survey corroborates the previous finding that female sex is an important risk factor for physical discomfort due to minimally invasive gynecologic surgery. [2] In our study, the rate of physical symptoms was 30 percentage points higher among female surgeons than among their male counterparts, and female surgeons had an odds ratio of 4.2 for physical symptoms compared to their male counterparts. Numbness, pain, stiffness, and fatigue were all reported at significantly higher rates by female surgeons. This is likely secondary to suboptimal laparoscopic equipment design, robotic console design, and table height for female surgeons, as both smaller glove size and shorter height have been found to correlate with increased physical strain in laparoscopic surgery. [1] In fact, ergonomic studies have shown that the robotic console allows for comfortable posture only for individuals 64-73 inches in height. [16] With women making up a higher proportion of gynecologists than of any other surgical subspecialty group, we must consider tailoring surgical training and surgical equipment to better accommodate female surgeons [17].

Our results suggest that younger age is a potential risk factor for physical discomfort due to minimally invasive surgery. Previous studies have led authors to hypothesize that younger surgeons experience increased symptoms because they have less skill and less experience [18]. However, we would argue that the increased rate of reported symptoms in younger surgeons may be confounded by an increased proportion of female surgeons in the younger age groups. In fact, among our survey respondents, females made up a significantly higher proportion of our younger age groups than of our older age groups.

Surgeons performing between 6 and 10 minimally invasive procedures per month reported physical symptoms more frequently than did those performing <6 per month. This is consistent with prior studies showing increasing surgeon discomfort with a heavier case load [1,3, 10]. However, our finding of decreased physical symptoms when performing >20 minimally invasive procedures per month suggests there may be a level of proficiency where

symptoms begin to decrease with extensive operative experience. These surgeons may also be operating within high volume academic facilities with residents and/or fellows performing part or all of the procedure.

Our survey is unique in that laparo-endoscopic single-site surgery was included in our laparoscopic surgery group. Previous studies found that approximately 62% of surgeons experienced more discomfort with laparo-endoscopic single-site surgery than with conventional laparoscopy [19]. This may indicate that the rate of reported symptoms in our laparoscopic group is higher than would have been observed with traditional laparoscopy alone. However, most likely only a small number of surgeons perform laparo-endoscopic single-site surgery, which would mean that inclusion of this type of surgery had a negligible impact on rates of reported symptoms. Further studies addressing this issue are warranted.

The selection bias in this survey is likely less than in other similar studies. Our questions regarding physical symptoms were only a small subset of a much larger survey regarding minimally invasive surgery. Unlike surveys solely addressing pain symptoms, the broader focus of our survey avoids the self-selection bias seen in similar studies where surgeons experiencing more pain symptoms are those more inclined to respond. This may account for the slightly lower rate of reported symptoms in our survey than the previously published 88% [1].

Our survey was not without limitation. Our response rate was low, at 32%, but this is consistent with response rates for other voluntary surveys [1, 3]. Our survey was very thorough, with a total of 46 questions. However, the length of the survey may have deterred surgeons in a very busy oncology practice from completing questionnaire. Numbness, stiffness, pain, and fatigue were not clearly defined within the survey allowing for subjective interpretation of these symptoms. Furthermore, our survey did not evaluate the impact that patient characteristics such as BMI may have on surgeon discomfort. However, as may be expected, a previous study by Franasia et al., showed increasing surgeon discomfort with laparoscopy as patient BMI increases [1]. Our survey also did not evaluate the impact of total operative time, location and degree of physical symptoms, or the treatment for these symptoms when treatment was sought. Further studies evaluating this are warranted in the future as prolonged procedures may add to physical discomfort and location of symptoms may differ between surgical modality. Finally, a potential large limitation of this study is the insufficient evidence to support a direct causal relationship between robotic surgery and physical symptoms. We are unable to determine if respondents who predominantly utilize the robotic platform reported symptoms specifically related to its use, or rather they preferentially used that modality in attempts to alleviate pain symptoms originally encountered during open or laparoscopic surgery. If a significant number of respondents did in fact do so, it does not appear that the robotic system alleviated these symptoms.

Despite limitations of this survey, our finding that 61% of gynecologic cancer surgeons reported physical symptoms due to minimally invasive surgery is alarming. Risk factors for this physical discomfort appear to be robotic surgery and female sex. Our survey results suggest that robotic surgery may not be quite as ergonomically advantageous as previously thought. As we continue to strive to improve patient outcomes and to decrease patient

morbidity with the use of minimally invasive surgery, we must also work to improve the ergonomics of minimally invasive surgery for surgeons.

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Research Highlights

- A significant number of gynecologic oncologists experience adverse symptoms related to performing surgery
- Independent risk factors for adverse physical symptoms were female gender and use of the robotic system

Précis

Gynecologic oncologists report significant pain and physical discomfort related to minimally invasive surgery.

Table 1**Survey Questions about Physician Discomfort [3]**

Question	Response Options
Have you had any physical discomfort or symptoms you would attribute to laparoscopic operating?	Single response
Yes	
No	
If you HAVE HAD physical discomfort attributed to your laparoscopic operating, indicate below your symptoms.	Multiple responses allowed
Numbness	
Stiffness	
Fatigue	
Pain	
History of treatment received for individual body parts	
Describe any other injuries or conditions that are not included in previous question.	Descriptive
When do you experience the symptoms or discomforts noted in previous questions?	Single response
While performing surgery, immediately after, and persistently	
While performing surgery, immediately after, but not persistently	
While performing surgery, not immediately after, still persistently	
Only when performing surgery	
Not while performing surgery, but immediately after and persistently	
Other	
How have you attempted to minimize these injuries or conditions?	Multiple responses allowed
Changing instruments	
Changing postural position	
Ignoring any injury or condition	
Taking a break	
Other	
Which of the operating room factors below appear to minimize your physical complaints?	Multiple responses allowed
Display monitor location	
Instrument design	
Operating room table set-up	
Type of display system	
Other	

Table 2

Physical Symptoms by Surgical Approach

Symptom	No. of Surgeons (%)			p Value
	Robotic (n=122)	Laparoscopic (n=67)	Abdominal (n=61)	
Any symptom	88 (72)	38 (56)	30 (49)	0.0052
Numbness	31 (25)	8 (11.9)	12 (19)	0.0876
Pain	52 (42)	24 (35.8)	18 (29)	0.2170
Stiffness	60 (49)	29 (43.3)	18 (29)	0.0373
Fatigue	61 (50)	25 (37)	17 (27)	0.0125

Table 3

Physical Symptoms by Sex

Symptom	No. of Surgeons (%)		p Value
	Female (n=107)	Male (n=229)	
Any symptom	87 (81)	117 (51)	<0.0001
Numbness	36 (33)	31 (13)	<0.0001
Pain	46 (43)	73 (31)	0.051
Stiffness	60 (56)	85 (37)	0.001
Fatigue	55 (51)	74 (32)	0.001

Table 4

Physical Symptoms by Age

Symptom	No. of Surgeons (%)					p Value
	30-40 Years (n=72)	41-50 Years (n=114)	51-60 Years (n=91)	61-70 Years (n=48)	>70 Years (n=19)	
Any symptom	53 (73)	80 (70)	55 (60)	16 (33)	4 (21)	<0.0001
Numbness	14 (19)	24 (21)	19 (20)	9 (18)	0 (0)	0.2129
Pain	26 (36)	54 (47)	25 (27)	15 (31)	2 (10)	0.0040
Stiffness	40 (55)	60 (52)	33 (36)	14 (29)	2 (10)	0.0001
Fatigue	32 (44)	54 (47)	32 (35)	11 (22)	2 (10)	0.0018

Note: As not all respondents provided their age, age groups do not sum to 350

Table 5**Physical Symptoms by Other Surgeon Factors**

Surgeon Factor	No. (%) of Surgeons with Any Symptoms	p Value
Years performing minimally invasive surgery		0.17
<1	1/2 (50)	
1-5	36/53 (67)	
6-10	54/79 (68)	
11-15	49/71 (69)	
>15	63/113 (55)	
No. of cases/month		0.0007
1-5	18/40 (45)	
6-10	79/108 (73)	
11-20	80/119 (67)	
>20	25/48 (52)	
Training in minimally invasive surgery during fellowship, no. of cases/month		0.8
None	49/78 (63)	
5	85/136 (63)	
6-20	54/79 (68)	
>20	17/28 (61)	
Rate of conversion to laparotomy		0.0186
0%	20/35 (57)	
1-4%	132/211 (63)	
5-10%	47/63 (75)	
11-20%	6/11 (55)	
Practice type		0.02
Academic	101/156 (65)	
Community	46/87 (53)	
Both	60/89 (67)	
Other	3/11 (27)	
Assistant Type		NA
Fellows/Resident	166/254 (65)	
General Obstetrician	50/81 (61)	
General Surgeon	16/26 (62)	
Gynecologist Oncologist	52/73 (71)	
Operating Room Staff	90/138 (65)	

Note: As not all respondents provided complete data, subgroups may not sum to 350

Table 6

Summary of Logistic Regression Analysis of Predictors of Any Symptom

		Univariate			Multivariate		
	N (Events)	P Value	OR	95% CI	P Value	OR	95% CI
Surgery type							
Laparotomy	61 (30)		Ref			Ref	
Robotic	122 (88)	0.0026	2.67	1.41-5.07	0.0127	2.38	1.20-4.69
Laparoscopy	67 (38)	0.3939	1.35	0.68-2.72	0.5001	1.29	0.62-2.71
Sex							
Male	229 (117)		Ref			Ref	
Female	107 (87)	<0.0001	4.16	2.40-7.22	<0.0001	4.20	2.13-8.29
Age, years							
30-40	72 (53)		Ref				
41-50	114 (80)	0.6133	0.84	0.44-1.63			
51-60	91 (55)	0.0790	0.55	0.28-1.07			
61-70	48 (16)	<0.0001	0.18	0.08-0.40			
>70	19 (4)	0.0002	0.10	0.03-0.32			
No. of cases per month							
1-5	40 (18)		Ref				
6-10	108 (79)	0.0018	3.33	1.57-7.08			
11-20	119 (80)	0.0138	2.51	1.21-5.21			
>20	48 (25)	0.5086	1.33	0.57-3.08			
Practice type							
Academic	156 (101)		Ref				
Community	87 (46)	0.0705	0.61	0.36-1.04			
Both	89 (60)	0.6718	1.13	0.65-1.96			
Other	11 (3)						

CI, confidence interval; OR, odds ratio.