



Research Article

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Adhesion Awareness among Saudi Surgeons: A National Survey

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ABSTRACT

Background: Postoperative adhesions which are defined as the abdominal fibrous connections that develop between the organs and the peritoneum as a result of surgical trauma are a significant clinical problem. Studies are yet to understand the mechanisms of adhesions; however, most studies have reported that they involve disruption of the mesothelial surface with subsequent signaling processes of inflammation and fibrinocoagulation. **Methods:** 124 surgeons from 57 hospitals in Riyadh, Jeddah, Taif, Makkah, Dammam, Al Ahsa, Albaha, and Air Saudi Arabia were recruited from 04/09/2019 till 24/09/2019 by convenient sampling method. A questionnaire from a previous study "Adhesion Awareness: A National Survey of Surgeons" was adapted and sent to the surgeons to understand their perspectives on post-operative adhesions. The use of antiadhesives, the role of adhesiolysis, and electrocautery were also assessed. **Results:** All the respondents (n=124) responded to the questions giving a response rate of 100%, which was highly commendable for the validity of the study. A cumulative 79.8% (CI, 95) of the sample agreed that adhesions are of clinical interests. And, 36.7% of the respondents expressed a positive attitude towards adhesion prevention; while, 26.7% of the sample were not in support of adhesion prevention. 49.2% disagreed with the notion that they experience a lack of clarity about when to use anti-adhesives; while, 29.9% agreed that they experience a lack of clarity on when to use ant-adhesives. **Conclusion:** While surgeons are increasingly becoming aware of the effects of postoperative adhesions, more awareness needs to be conducted.

Key words: Adhesions, post-operative, surgeon.

INTRODUCTION

Postoperative adhesions which can be defined as the abdominal fibrous connections that develop between the organs and the peritoneum as a result of surgical trauma are a significant clinical problem. Studies are inconclusive on and are yet to fully understand the mechanisms of adhesions; however, most studies have reported that they involve disruption of the mesothelial surface with subsequent signaling processes of inflammation and fibrinocoagulation [1]. Etiologic causes of adhesion may be organized into different groups, namely post-surgical, post-inflammatory, and post-radiation [2, 3]. Post-surgical causes are the major causes, as mounting evidence has established about 90% of abdominal adhesions to be due to previous abdominal surgery, essentially open surgery (laparotomy) and laparoscopic surgery to a lesser degree [4]. In given research, the formation of intra-abdominal adhesion was intraoperatively found in nearly 95% of individuals that had experienced laparotomy at one point [5]. The clinical burden of postoperative adhesions is extensive taking into account that up to 33% of those who have undergone surgery would get readmission for complications associated with adhesions in the next decade [6]. Also, the average readmission rate is relatively high (2.2 per patient) [6]. Adhesions continue to be a scourge following pelvic and abdominal surgery. Among its potential consequences are difficulty repeating surgical procedures, bowel obstruction, pelvic and abdominal pain, and female fertility with increased ectopic pregnancy risk, especially in subsequent conceptions [7]. Furthermore, postoperative adhesions might impede the intraperitoneal chemotherapy disbursement among individuals with pelvic or abdominal cancer [8]. They form in between 55% and 100% of patients after gynecologic surgery [9, 10]. Thus, it is crucial for healthcare to regard adhesions as an extremely significant complication due to abdominal surgery rather than as a side effect.

Currently, effective treatment for adhesions does not exist, and although two approaches, namely a laparoscopic and an open approach, have been proposed, professionals and scholars have hotly contested against surgical treatment, as it causes reformation of adhesions [11, 12]. As such, the best way to manage adhesions is to prevent its occurrence. Using the meticulous surgical method to reduce surgical trauma is the major step that has to be always implemented. By contrast, carrying out surgery would somewhat lead to surgical trauma, which can be minimized further by reducing operative time [13], wetting tissues [14], and utilizing powder-free gloves [15]. As a result, using anti-adhesion barriers as a way to further prevent adhesion is extremely difficult to avoid. An increasing amount of open general surgery and gynecologic studies have proven modified carboxymethylcellulose and hyaluronic acid to be effective barriers to reduce adhesions by mechanically separating surfaces of injured tissues in peritoneal repair [16]. Although not approved for CD use, oxidized-regenerated cellulose has also been shown to be clinically beneficial in open gynecologic surgeries [17-19]. Moreover, laparoscopic gynecologic surgery studies have shown that administering an icodextrin solution that spreads across the peritoneal cavity can reduce adhesions [20, 21].

As previously highlighted, the risk of morbidity due to adhesions remains for up to a decade unlike the majority of surgical complications. Besides, patients often encounter different symptoms of adhesion-related complications, and research has not discovered the best remedy for the condition. As a result of these considerable aspects, surgeons have undervalued postoperative adhesions. Such undervaluation has made physicians rarely mention or include them in the process of informed consent [22-24]. However, their failure to make everything clear during the process, based on the many successful negligence claims already seen, may be considered as the health professional's duty of care omission [23].

Even though the descriptions evidence the serious effects and degree of postoperative adhesions, surgeons have been largely perceived to lack knowledge and awareness of this clinical problem. Also, in addition to taking inadequate preventive steps against these adhesions, they give insufficient informed consent. Nevertheless, an adequate amount of research is yet to be conducted to date to prove these assumptions not only in the context of Saudi Arabia but in the global context as well. Consequently, this study performed a multicenter survey to assess the behavior toward and awareness of perioperative adhesions among Saudi surgical trainees and practicing surgeons.

MATERIALS AND METHODS

Study design

This was a multi-center survey to document the awareness levels of Saudi surgeons regarding adhesions. The study adopted a cross-sectional design to understand the perspectives of surgeons on post-operative adhesions and its associated mortality and morbidity. To ensure accuracy and clarity of the questions, two independent

researchers, with experience in the design of surveys and multiple-choice tests, revised the questions. Thereafter, three surgeons and two trainees tested the surveys to determine the lack of clarity and subjective questions. After revising the survey as per the recommendations, the test group surgeons, the independent researchers, and the steering group reviewed the survey again and eventually approved it. The questionnaire survey contained a total word count of 516 and constituted 27 multiple-choice questions. However, to get a deeper understanding of the participants' insights and add more data to the quantitative data, the survey included open-ended questions. For respondents' better understanding, the final layouts, in which there was both a printed version and an electronic online version, were available in the Arabic language.

Study setting and participants

In this study, 124 surgeons from 57 hospitals in Riyadh, Jeddah, Taif, Makkah, Dammam, Al Ahsa, Albaha, and Air Saudi Arabia were recruited from 04/09/2019 till 24/09/2019 by convenient sampling method. A questionnaire from a previous study "Adhesion Awareness: A National Survey of Surgeons" (DOI: 10.1007/s00268-010-0778-8) was adapted. The questionnaire was distributed in hardcopy to the participants after the morning meeting as it was the best time to locate the surgeons in one place. Potential respondents were included regardless of age, race, ethnicity, and religion as long as they were registered and were working in Saudi Arabia. Notably, we recognized that there will be serious challenges in any medical research, such as approval by the university and Institutional Review Board (IRB) for the sample hospitals that we included and participation at each level by surgeons, ranging from administration to the lower level staff surgeons. In the university and all the hospitals, we involved key administrators in the research design to navigate both the policy and structural changes.

Knowledge test/Variables

With regard to the prevalence and morbidity of adhesions, the study formulated eight multiple-choice questions based on best-available and up-to-date evidence (2016 update). In doing so, the research considered the following statements to be correct:

- Postoperative adhesions cause approximately 56% of the small bowel-obstructions [24].
- There is an approximately 5% five-year rate of readmission following laparotomy directly associated with postoperative adhesions [25].
- There is an approximately 30% ten-year rate of readmission following laparotomy associated with postoperative adhesions [26].
- Iatrogenic bowel injury is experienced in about 40% of the operations in about one-hour adhesiolysis [24].
- Compared to partial small-bowel resection, cholecystectomy, appendectomy, or resection of the rectum, a total colectomy causes the highest adhesion risk [25].
- Approximately 23% of women with a history of abdominal injury would seek treatment for fertility [24].
- In comparison to younger patients, patients above the age of 60 years are connected to the fewer formation of adhesion. Besides, in comparison with patients without a history of abdominal surgery, patients with a history of abdominal surgery are a greater likelihood of adhesion formation. Notably, there is no relationship between adhesion formation and Crohn's disease [25].

Statistical Methods and Analysis

This was a cross-sectional study to understand the perspectives of surgeons on post-operative adhesions. The respondent subgroups were defined as general surgeons, specialized surgeons, and trainees. With the help of the χ^2 test, we made comparisons of the proportions. To compare between the groups, we used different tests with posthoc Bonferroni correction, including the Kruskal-Wallis, the Wilcoxon signed-rank test, or the Mann-Whitney U test. Similarly, with posthoc Bonferroni correction, ANOVA test was used to compare Knowledge test scores. Spearman's rank correlation was used for correlation calculation and a $p < 0.050$ was treated as statistically significant. SPSS version 23.0 was used for statistical analysis.

RESULTS OF THE STUDY

A total of 124 surgeons spread across 57 hospitals were contacted through email to understand their perspective on adhesions. All the respondents ($n=124$) responded to the questions giving a response rate of 100%, which was highly commendable for the validity of the study. The total number of female specialists contacted for the survey

was (n=60) and that of males was (n=64). All the respondents contacted for their perspectives on adhesions meticulously responded to the study questions. A frequency table with the general data is shown in Figure 1. The number of female doctors were almost matched with that of males to reduce bias in the study, with respect to gender. Inclusive data ensures its generalizability in other settings apart from the Kingdom of Saudi Arabia.

Table 1. The percentage of gender groups

Gender		N	%
	Female	60	48.4
	Male	64	51.6
	Total	124	100.0

Work area was also another point of concern for the study. Previous studies have indicated that perspectives on adhesions differ based on experience and work area. Specialist surgeons (with extensive experience in their respective fields) often feel that postoperative adhesion is an issue of concern, based on the number of readmissions. In the study, general surgeons (n=51), resident (trainee) n=51, and specialized surgeons (n=22) participated.

Table 2. The participants' working area

Work Area		N	%
	General surgeon	51	41.1
	Resident (Trainee)	51	41.1
	Specialized Surgeon	22	17.7
	Total	124	100.0

Specific analysis for each of the study questions is provided in the following section:

Table 3. An analysis with regard to question 1

Work Area		Adhesions are not of clinical interest				Total
		Disagree	Neutral	Strongly Disagree	Totally disagree	
	General surgeon	19	12	7	13	51
	Resident (Trainee)	18	9	11	13	51
	Specialized Surgeon	10	4	6	2	22
	Total	47	25	24	28	124

A total of 37.9% disagreed with the question "adhesions are not of clinical interest". From the table, 79.8% (CI, 95) disagreed with the leading question that adhesions are not of clinical interests. This number represents a significant majority of specialists believing that adhesions are of clinical interest. From the results, it is evident that surgeons are increasingly becoming aware of the effects of postoperative adhesions.

Table 4. An analysis with regard to question 2

Which of the following procedures carries with it the highest risk		N	%
	Appendectomy	19	15.3
	Partial small bowel resection	24	19.4
	Proctectomy	23	18.5
	Total proctocolectomy	58	46.8
	Total	124	100.0

For the knowledge test, respondents scored 46.8% correct answers, with specialized surgeons scoring slightly higher results as compared to general surgeons and trainees.

Adhesion prevention

Prevention of post-operative adhesion is emerging as an issue of immediate concern. Analysis of the perspectives of the respondents on preventing postoperative adhesion is shown in the table below, and varies significantly. For instance, in the table, n=28 of the sample agreed that they do not believe in adhesion prevention, with the highest among resident trainees. A higher percentage of specialized surgeons agree that adhesion prevention is necessary as compared to general surgeons and resident trainees.

Table 5. An analysis with regard to question 3

Work Area	You do not believe in adhesion prevention				
	Agree	Disagree	Neutral	Strongly Agree	Strongly Disagree
General surgeon	11	12	10	7	11
Resident (Trainee)	14	5	10	10	12
Specialized Surgeon	3	6	6	2	5
Total	28	23	26	19	28

Equally, considering the chi square test shown in the figure, a faint correlation is established between adhesion prevention and seniority (specialized surgeons believe that the prevention of adhesion is a necessary step) as compared general surgeons and resident trainees. For the study, 36.7% of the respondents expressed a positive attitude towards adhesion prevention; while, a 26.7% of the sample were not in support of adhesion prevention. Of the samples, specialized surgeons were more in agreement for adhesion prevention as compared to other specialists such as trainees and general surgeons. A significant issue of concern is when to use anti-adhesive for many of the respondents. For the study, 49.2% disagreed with the notion that they experience a lack of clarity about when to use anti-adhesives; while, 29.9% agreed that they experience a lack of clarity on when to use anti-adhesives. Of the respondents who agreed with the fact that they lack clarity on when to use anti-adhesives, trainees (56.7%) and general surgeons 51.65% were disproportionately represented as compared to specialized surgeons (16.75%) (95% CI).

Anti-adhesive agents

As expressed in the previous section, the use of anti-adhesive agents differs greatly based on several factors, including experience. Specialized surgeons are more likely to express knowledge of when to use anti-adhesives (48.9%, cumulative percentage) as compared to other categories (17.67%, cumulative percentage). Equally, for the study, 41.9% of the respondents preferred using locally acting anti-adhesive agent as compared to 37.9% of the respondents (cumulative values).

Table 6. An analysis with regard to questions 4, 5, 6 & 7

	You dont believe in anti-adhesive agents	You experience a lack of clarity about when to use an anti-adhesive	You prefer using a locally acting anti adhesive agent	You think the costs do not outweigh the possible benefits of antiadhesives
Agree	21.0%	10.5%	25.0%	24.2%
Disagree	21.0%	23.4%	19.4%	20.2%
Neutral	16.1%	21.0%	20.2%	17.7%
Strongly Agree	18.5%	19.4%	16.9%	21.8%
Strongly Disagree	23.4%	25.8%	18.5%	16.1%

Cost is another factor influencing the choice and use of anti-adhesives for many of the respondents. However, a significant majority i.e. 46% (cumulative percentage) of the respondents believe that cost should not be a barrier to the use of anti-adhesives.

DISCUSSION AND CONCLUSION

Knowledge on post-operative adhesion is an issue of interest, especially in contemporary medicine. For the case of KSA, general surgeons and trainees have a limited understanding of the role and effects of adhesions. For

instance, the use of anti-adhesive agents for the study fails to match the extent and impact required of postoperative adhesions. Consistent with various findings, awareness about post-operative adhesions is established in advanced specialists as compared to general surgeons and other trainees. In the study, specialized surgeons in KSA have a higher understanding (46.78%) of the nuances of postoperative adhesions as compared to general surgeons and trainees (21.75%). The information implies that there is a need for awareness about the effects of adhesions with specific focus on the trainee and general surgeon population. This would increase their understanding about fundamental factors, including the need for anti-adhesives, cost as a non-factor in the use of anti-adhesives, the importance of local anti-adhesives among a myriad of factors. Previous studies have demonstrated that awareness of adhesions among non-surgeon specialist is often limited. For instance, a study on Dutch gynecologists indicated that only 5.2% of the sample (n=230) reported informing their patients routinely about the need for informed consent before surgery. Equally, a significant population of patients were only informed before laparotomy as compared to laparoscopy [24]. The formation of adhesions after laparoscopy is often higher as compared to laparotomy due to various reasons, including the chimney effects of the carbon dioxide oxide gas and its associated intra-abdominal pressure, causing peritoneal drying and mesothelial ischemia.

Adhesions are further associated with significant risks and serious complications, including morbidity and mortality. And, with the increased instances of medico-legal claims associated with adhesions, there is a need to understand the implications of the condition. Previous studies have indicated that adhesiolysis as a remedy for chronic abdominal pain comes with associated risks, including the chances of adhesion reformation. However, the survey realized that many of the respondents do not understand the impact of adhesiolysis. For instance, considering the table below up to (22.6% +16.9%, a cumulative 39.5%) disagreed that adhesiolysis for complaints of pain is not effective. This indicate acute lack of knowledge on the topic.

Table 7. An analysis with regard to question 8

Adhesiolysis for complaints of pain is not effective		N	%
	Agree	29	23.4
	Disagree	28	22.6
	Neutral	17	13.7
	Strongly Agree	29	23.4
	Strongly Disagree	21	16.9
	Total	124	100.0

The results further establish that surgical trainees have less understanding of the nuances involving adhesions, and are more likely to declare that adhesions are not of clinical interests as compared to specialists. In another study, trainee surgeons were found to be less likely to inform patients of the negative effects of adhesions, including mortality and morbidity, to rely less frequently on surgical techniques to reduce adhesions, and to have higher chances of using antiadhesive agents as compared to specialists and surgeons [24, 25]. It is not yet understood why trainee surgeons would not likely inform patients about adhesions and related morbidity; however, it is hoped that such a behavior could change when they have more responsibilities, like follow up on clients [24]. On the other side, this could significantly increase the chances of the population (general surgeons) experiencing negligence related claims.

Further, a significant majority of the respondents believes that meticulous procedures reduce the occurrence of post-operative adhesions. For the study, a significant majority (51%) of the respondents agreed that meticulous procedures greatly reduce the chances of a patient experiencing adhesions. These findings are in line with previous studies conducted about awareness of post-operative adhesions among Dutch Surgeons (24). Information about the use of anti-adhesive agents is limited, with trainees having less knowledge of when to use anti adhesives. Specialized surgeons are more likely to have express knowledge of when to use anti-adhesives (48.9%, cumulative percentage) as compared to other categories (17.67%, cumulative percentage). Equally, for the study, 41.9% of the respondents preferred using locally acting anti-adhesive agent as compared to 37.9% of the respondents. The findings suggest the need for awareness about the use of anti-adhesives among surgeons, with specific focus on the trainee and general surgeons. Previous studies have indicated the negative attitude towards the use of anti-adhesives among surgeons, which correlates with uncertainty. However, the lack of information and clinical

studies on the use of anti-adhesive agents is cited as one of the possible reasons for the uncertainty and reduced use of agents by surgeons.

Additionally, a significant majority (54%) of the respondents do not believe that “extraperitoneal mesh position causes fewer adhesions than the intraperitoneal mesh position”, a majority (56%) do not believe that a coated mesh causes fewer adhesions than a noncoated mesh, 63% believe that electrocautery causes fewer adhesions, and 57% disagree that less intraperitoneal suture material reduces adhesions. A descriptive summary of the responses is shown in Figure 1:

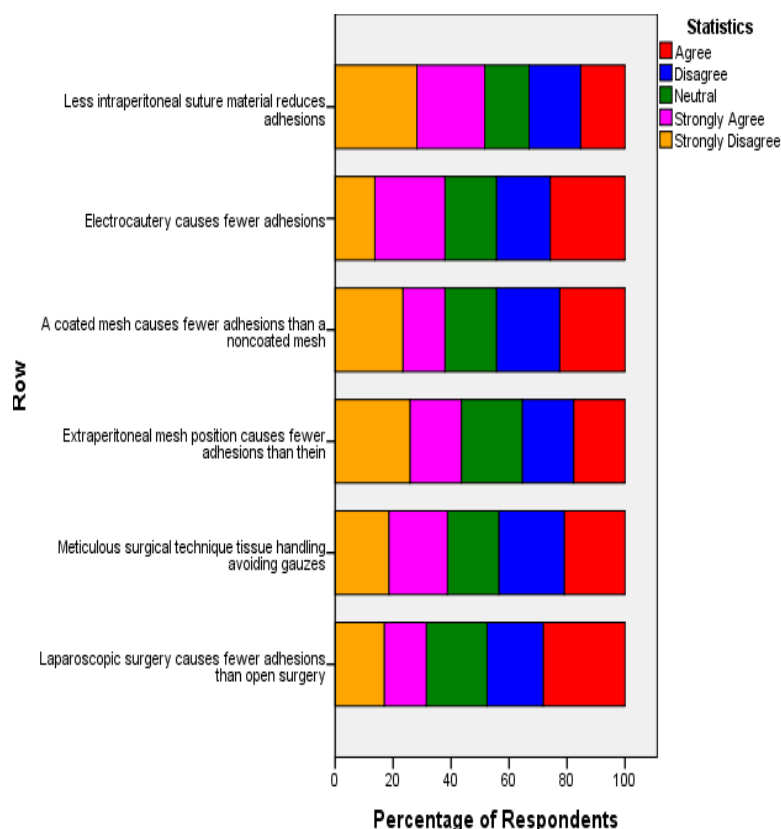


Figure 1. A descriptive summary of the responses

Limitations

Studies do normally have limitations, and the current one was no exception and thus should be pointed out. Saudi Arabia does not have a central database with enough information about its surgeons, making it very challenging for the study to carry out a detailed nonresponse analysis. By contrast, the participants were from the major Saudi hospitals with large surgical departments. To add to this, the response rates were significantly higher compared to the recent national surveys conducted in 2010 (34.4%) and 2016 (32.6%) among Dutch surgeons on a similar topic but in the context of the Netherlands [23, 27]. The current relatively higher rate may be as a result of focusing on a few numbers of centers rather than a national survey, which may improve the rates of response but does not impact quality.

As evident in the methodology section, our research used up-to-date and best-available evidence for the knowledge test selected by the general and gynecologic surgeons’ steering committee. As a way of ascertaining comprehensibility and facing and contenting the survey’s validity, the study performed rounds of pilot testing. Despite these significant efforts and even though we used a somewhat large cohort researcher for the majority of the questions, some may as well see controversy in the consistent high morbidity that the research may have established. Indeed, most respondents would still focus on the amount of the problem even with lower actual morbidity.

Lastly, our research solely performed a survey on Saudi surgical trainees and surgeons; however, the findings would most probably be used for other surgeons in other countries across the globe, thereby extending beyond Saudi Arabia. After all, patients often experience adhesions following abdominal surgeries and the associated costs, mortality, and morbidity are either lower or higher depending on those countries.

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