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Does active smoking really matter before ventral hernia repair? An AHSQC analysis ☆,☆☆,★

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ABSTRACT

Background: Many studies implicate active smoking as a risk factor for postoperative wound complications and all 30-day morbidity, but the definitions of inclusion and exclusion criteria as well as outcome parameters are inconsistent. Critically, the ability of large databases and meta-analyses to generate statistically significant associations of active smoking with morbidity do not address whether those relationships are actually clinically meaningful. We investigated this relationship after open ventral hernia repair.

Study Design: Patients undergoing elective open ventral hernia repair in clean wounds with 30-day follow-up were extracted from the Americas Hernia Society Quality Collaborative. Current smokers (within 30 days of surgery) were 1:1 propensity matched to patients who had never smoked based on demographics, comorbidities, and operative characteristics. Wound complications and all 30-day morbidity were assessed.

Results: After matching 418 current smokers to 418 patients who had never smoked, the groups were similar with the exception of minor differences in body mass index (31.4 vs 33.3, $P < .001$) and incidence of chronic obstructive pulmonary disease (18% vs 6%, $P < .001$). Rates of surgical site occurrence were greater in active smokers (12.0% vs 7.4%, $P = .03$) driven by increased rates of wound cellulitis (2.4% vs 1.2%) and seroma (5.5% vs 1.2%); however, rates of surgical site infection (4.1 vs 4.1, $P = .98$), surgical site occurrences requiring a procedural intervention (6.2% vs 5.0%, $P = .43$), reoperation (1.9% vs 1.2%, $P = .39$), and all 30-day morbidity (7.5 vs 6.6, $P = .60$) were not significantly increased in active smokers. There were no instances of mesh excision.

Conclusion: Active smoking prior to elective clean OVHR is associated with clinically insignificant differences in wound morbidity. Surgeons allowing perioperative smoking should monitor their outcomes to assure these findings are replicable in their own practice.

Introduction

The impact of active smoking on the 380,000 ventral hernias repaired annually in the United States is important to understand because 15% of Americans continue to smoke.[1,2] In addition to the myriad of well-documented detrimental health effects of smoking, such as cardiovascular disease, pulmonary compromise, and cancer risk, there is no shortage of literature to corroborate the negative association of preoperative smoking with postoperative morbidity.[3–6] In pooled data from all surgical subspecialties, active smoking has been associated with increased rates of wound morbidity, including surgical site infection.[3] Specifically in the context of open ventral hernia repair (OVHR), large data pools from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) have implicated smoking as a risk factor for wound infection, respiratory complications, and all other infectious complications.[4,5] Meanwhile, randomized controlled trials (RCT) have demonstrated that preoperative smoking cessation at least 4 weeks before an operation can decrease rates of postoperative complications and wound morbidity.[7,8] Needless to say, the evidence against preoperative smoking appears tremendous.

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Nevertheless, most analyses involving perioperative smoking have notable pitfalls when it comes to their broad applicability. Some investigators have pooled heterogeneous surgical populations and most use inconsistent definitions of smokers (ie, what designates a "current" smoker), the control group (former smoker versus never smoker), and the outcome of interest.[3–5] Data from NSQIP is unable to adjust for hernia-specific operative variables, such as hernia dimensions, mesh type and position, and use of skin flaps and myofascial release.[4–6, 9] Also, multi-institutional databases and meta-analyses are able to generate statistically significant *P* values and odds ratios even with small clinical differences attributable to a large denominator.[10] Unfortunately, there is often little discussion of whether those differences are clinically meaningful.

We aimed to measure the association of active smoking within 30 days of operation, with postoperative wound morbidity and all 30-day morbidity in our most common clinical scenario—elective open ventral hernia repair (OVHR) in a clean setting. Using the database of the Americas Hernia Society Quality Collaborative (AHSQC), we would be able to account for hernia-specific operative variables. Given the abundance of literature condemning preoperative smoking, we hypothesized that current smokers would have increased rates of wound morbidity and that those differences would be clinically meaningful.

Methods

After obtaining approval from our institutional review board at the Cleveland Clinic Comprehensive Hernia Center (Cleveland, OH), data from the database of the AHSQC were queried for patients in a specific category, requiring having undergone an open elective VHR in a Center for Disease Control (CDC) wound class I, with completed 30-day follow-up. The AHSQC is an ongoing quality improvement effort that utilizes point-of-care data entry to track outcomes after hernia repair. To date, the database includes data from 311 academic, community, and academic-affiliated surgeons in a variety of clinical settings.[11] All patient data entered in the AHSQC were eligible for analysis, barring the aforementioned inclusion criteria. Patients were then subgrouped into "current smokers" (within 30 days of operation), "former smokers" (those who quit smoking > 1 month before operation), and those patients who had never smoked. To accentuate the potential impact of active smoking, we chose to use never smokers as the control arm.

After excluding former smokers, current smokers were matched using 1:1 propensity scoring to a group of never smokers, based on clinically relevant demographics, comorbidities, and operative characteristics. These demographic variables included age and sex, and comorbidities included body mass index (BMI), diabetes mellitus, hypertension, chronic obstructive pulmonary disease (COPD), steroid use, history of a previous surgical site infection (SSI) or hernia recurrence, American Society of Anesthesiologists classification, and Ventral Hernia Working Group grade. Matched operative characteristics included hernia width and length, creation of subcutaneous flaps or myofascial release, mesh type and location, need for a concomitant procedure, operating room time > 2 hours, and the ability to achieve fascial closure.

Outcomes between the matched cohorts of current and never smokers included standardized measurements of wound morbidity—SSI, surgical site occurrence (SSO), and surgical site occurrence requiring a procedural intervention (SSOPI).[12] SSIs were then classified based on the CDC definitions of superficial, deep, or organ space infections.[13] SSOs incorporated SSIs but also included wound cellulitis, nonhealing incisional wound, fascial disruption, skin or soft tissue ischemia, skin or soft tissue necrosis, serous or purulent wound drainage, stitch abscess, seroma, hematoma, infected or exposed mesh, or development of an enterocutaneous fistula. Discrepancies in specific SSO types (ie, wound cellulitis, seroma) were reported, including mesh excision. In addition to SSOPI, rates of reoperation were also specifically compared. Last, all 30-day morbidity was reported as any morbidity event entered into the AHSQC database within 30 days of operation. These outcomes included the following postoperative events: ileus, bowel obstruction, pulmonary embolism (PE), stroke, deep venous thromboembolism, pain requiring readmission, sepsis, septic shock, myocardial infarction (MI), cardiac arrest, urinary tract infection (UTI), acute kidney injury (AKI), renal failure, pneumonia, re-intubation, and other complications.

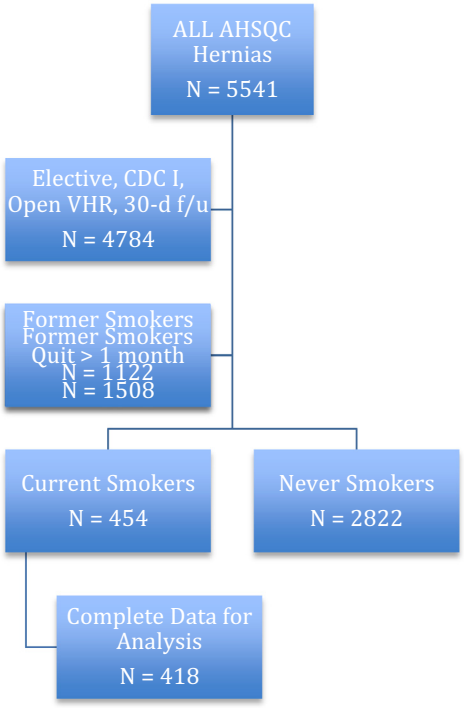

Fig. 1. Flow Chart of Inclusion and Exclusion Criteria.

Multivariate analyses were repeated on the matched samples to assess the impact of smoking status on the clinical outcome variables and to adjust for any potential differences in the matched groups (ie, imperfect matching). The odds ratio (OR), 95% confidence intervals (CIs), and *P* values were obtained for each outcome variable.

Results

We identified 4,784 elective OVHRs with a CDC I wound with completed 30-day follow-up within the AHSQC database. After excluding 1,508 former smokers, 454 current smokers and 2,822 never smokers remained for analysis. Patients with missing data fields were removed to optimize propensity matching and as such, 418 current smokers were matched in a 1:1 fashion with 418 never smokers (Fig. 1). Table 1 demonstrates that matched cohorts were similar with regard to demographics and comorbidities with the exception that current smokers had a lesser mean BMI (31.4 vs 33.3, $P < .001$), and greater rate of COPD (18% vs 6%, $P < .001$). Operative characteristics—summarized in Table 2—were statistically similar.

Rates of SSI were 4.1% for both current smokers and never smokers ($P = .98$). Superficial, deep, and organ space SSI rates were also similar for current and never smokers (2.9% vs 2.9%; 1.2% vs 1.0%, 0 vs 0.2%, respectively; $P = .53$), presented in Table 3. Rates of SSO, however, were greater in current smokers (12.0%

Table 1
1:1 Propensity matched demographics and comorbidities.

Demographics and comorbidities	Current smokers N = 418	Never smokers N = 418	*P* value
Age, y (mean ± SD)	52.7 ± 11.2	53.5 ± 11.2	.29
Female	52.6%	52.6%	.99
BMI (mean ± SD)	31.4 ± 6.9	33.3 ± 5.5	< .001*
Diabetes	19.4%	20.6%	.73
Hypertension	46.2%	47.1%	.84
COPD	18.4%	6.5%	< .001*
On steroids	2.4%	2.4%	> .99
History of SSI	18.6%	18.4%	> .99
History of hernia recurrence	35.4%	35.4%	> .99
ASA			> .99
– 1	2.6%	2.9%	
– 2	35.2%	35.9%	
– 3	59.1%	58.1%	
– 4	0	0	
VHWG			0.08
– 1	0	1.2%	
– 2	81.3%	80.4%	
– 3	18.7%	18.4%	
– 4	0	0	

ASA, American Society of Anesthesiologists; VHWG, Ventral Hernia Working Group

Table 2
1:1 Propensity matched operative characteristics.

Operative characteristics	Current smokers N = 418	Never smokers N = 418	*P* value
Hernia width, cm (mean ± SD)	7.7 ± 5.3	7.7 ± 4.7	.97
Hernia length, cm (mean ± SD)	12.0 ± 8.2	11.7 ± 7.6	.54
Operating room time ≥2h	62.4%	62.9%	.94
Skin flaps raised	28.2%	28.2%	> .99
Myofascial release	58.4%	60.5%	.57
Fascial closure	97.4%	97.4%	> .99
Concomitant procedure	17.5%	16.5%	.78
Mesh type			> .99
Permanent synthetic	91.4%	91.4%	
Absorbable synthetic	6.2%	6.2%	
Biologic	1.9%	1.9%	
Unknown	0.5%	0.5%	
Mesh location			.45
Onlay	6.7%	8.1%	
Inlay	5.0%	3.6%	
Sublay/underlay	88.3%	88.3%	

Table 3
Wound morbidity outcomes after 1:1 propensity matching.

Wound morbidity	Current smokers N = 418	Never smokers N = 418	*P* value
SSI	4.1%	4.1%	.98
Superficial	2.9%	2.9%	.53
Deep	1.2%	1.0%	
Organ space	0	0.2%	
SSO	12.0%	7.4%	.03*
Wound cellulitis	2.4%	1.2%	.19
Seroma	5.5%	1.2%	.0005
Other	4.1%	5.0%	.52
SSOPI	6.2%	5.0%	.43
Reoperation	1.9%	1.2%	.39
Mesh excision	0	0	

vs 7.4%, $P = .03$). The difference in SSO rates was driven by increased rates of wound cellulitis (2.4% vs 1.2%, $P = .19$) and seroma (5.5 vs 1.2%, $P = .0005$) in current smokers. Other individual SSO events were rare, but when pooled were no different in current smokers (4.1% vs 5.0%, $P = .51$). Regarding SSOPIs and rates of reoperation, rates were similar in current and never smokers (6.2% vs 5.0%, $P = .43$; 1.9% vs 1.2%, $P = .39$). There were no reports of partial or complete mesh excision in either group at 30 days.

Regarding all 30-day morbidity, rates of individual morbidity outcomes are reported in Table 4. Rates of individual complications were low, and there were no statistical differences in any individual morbidity category. When pooled, the total 30-day complication rates were 7.5% for current smokers and 6.6% for never smokers ($P = .60$).

Next, multivariate logistic regression did not show that current smokers had increased odds of SSI (OR 1.01, 95% CI 0.98–1.03, $P = .73$) or SSOPI (OR 0.99, 95% CI 0.80–1.18, $P = .79$). Of note, BMI and COPD were also investigated using multivariate logistic regression, given their statistical differences in propensity-matched groups; however, neither BMI nor COPD were independently associated with increased odds of SSI, SSO, or SSOPI (Table 5).

Table 4
All 30-day morbidity outcomes after 1:1 propensity matching.

All 30-day morbidity	Current smokers N = 418	Never smokers N = 418	*P* value
Ileus	6	4	.39
Bowel obstruction	1	1	> .99
Pain requiring readmission	4	3	.69
PE	2	1	.56
DVT	1	1	> .99
Stroke	1	0	.32
Sepsis	1	1	> .99
Septic shock	1	1	>.99
MI/cardiac arrest	0	0	NA
UTI	2	1	.56
Renal insufficiency	1	1	>.99
Renal failure	0	1	.32
Pneumonia	5	2	.23
Re-intubation	1	2	.56
Other complication	8	11	.45
Total	34 (7.5%)	30 (6.6%)	.60

Table 5
Multivariate logistic regression for current smoking in OVHR patients

	SSI			SSO			SSOPI		
	OR	95% CI	*P* value	OR	95% CI	*P* value	OR	95% CI	*P* value
Current smoking	1.01	0.98–1.03	.73	0.95	0.92–0.99	.03*	0.99	0.80–1.18	.79
BMI	1.00	0.99–1.00	.35	1.00	0.99–1.00	.26	1.00	1.00–1.00	.17
COPD	1.01	0.97–1.06	0.65	1.01	0.94–1.01	0.85	1.01	0.96–1.07	0.60

Discussion

Our aim was to measure the association of active smoking with wound morbidity in patients undergoing elective, OVHR in the category of clean (CDC I) wound class. Somewhat surprisingly, propensity-matched groups of current smokers versus never smokers from the AHSQC database had similar rates of SSI (4.1 vs 4.1, $P = .98$), SSOPI (6.2% vs 5.0%, $P = .43$), reoperation (1.9% vs 1.2%, $P = .39$), and all 30-day morbidity (7.5 vs 6.6, $P = .60$). Although current smokers had a 4.6% increased rate of SSO (12.0% vs 7.4%, $P = .03$) driven by increased rates of wound cellulitis (2.4% vs 1.2%, $P = .19$) and seroma (5.5 vs 1.2%, $P = .0005$), we interpret this to be unimportnant, given the minimal difference in subsequent procedural interventions and reoperations. Although active smoking is commonly regarded as a hazardous preoperative risk factor, well-matched groups of clean, elective OVHRs show that the impact of active smoking in this group of patients with CDC class I wounds may not be as dramatic as it is often regarded in this context.

These findings contradict an abundance of literature that condemns active preoperative smoking. The most commonly cited is the meta-analysis by Sorensen[3] of 140 cohort studies from multiple surgical subspecialties that associates active smoking with increased rates of wound necrosis (OR 3.6), wound dehiscence (OR 2.1), and SSI (OR 1.8). Although comprehensive, the analysis of this heterogeneous group of studies—including thoracic, orthopedic, and plastic surgery cases—may not be broadly applicable to our group of elective, clean, OVHRs, accounting for the difference in findings. Furthermore, their assessment of bias found a discrepancy "between studies reporting crude incidence rates and adjusted ORs, indicating that some degree of publication bias was present in these studies."[3] For instance, reporting an OR of 1.5, with a P value of $< .05$ and conclusive certainty of a meaningful association, is more definitive and convincing to the reader—and perhaps the editor—than deliberating the clinical significance of a 2% vs 3% complication incidence.

More pertinent to our work is a comparison with other large database reviews investigating the impact of smoking on VHR specifically. Large data pools from NSQIP have implicated smoking as a risk factor for wound infection, respiratory complications, and all other infectious complications.[4-6,9] Several important observations, however, could account for the discrepancy in our comparative findings. First, all NSQIP studies define active smoking as within 1 year of operation and are unable to account for those who quit preoperatively; in contrast, our definition of active smoking was within 30 days of operation. Next, key operative details, such as hernia size, mesh location, or technical adjuncts like use of myofascial release or skin flaps, are absent from all NSQIP analyses. Contrarily, we were able to use surgeon-entered operative details in our propensity analysis to create comparable groups. In the 2005 NSQIP analysis by Finan et al,[4] of 1,505 VHRs at 13 Veterans Association hospitals, they found a two-fold increase in their rate of SSI among active smokers; however, their cohort included emergent, contaminated, and laparoscopic cases, creating a more heterogeneous group, and the actual crude incidence rates between smokers and nonsmokers are not shown. Likewise, Kubasiak et al,[5] in their 2017 NSQIP report of 72,350 VHRs, they included emergent, contaminated, and laparoscopic cases. Although their multivariate analysis showed that current and previous smokers had increased rates of respiratory, wound, and all infectious complications (OR 1.1–1.9), the raw incidence of complication rates is less dramatic; wound complications were 4.3% in never smokers vs 4.1% in those with any smoking history (greater wound morbidity rates in those with *no* smoking history), and were 4.4% in previous smokers vs 6% in active smokers within 12 months. All infectious complications in this cohort were 1.5% vs 1.5% in never smokers versus those with any smoking history, and 1.6% vs 2.3% in former versus active smokers. All these findings had a statistical significance of $P < .0001$ (including 1.5% vs 1.5%), which is attributable to the large sample size of > 72,000 cases.[5] Most recently, the 2018 NSQIP analysis by Delancey et al[6] of 220,000 ventral and inguinal hernias excludes emergent and recurrent repairs, but the inclusion of inguinal hernias again makes it a more heterogeneous group. The large cohort demonstrates all wound morbidity rates of 2.6% vs 1.7% ($P < .001$) in smokers versus nonsmokers, and multivariate analysis confirmed that smoking is significantly associated (OR

1.4); however, the authors ultimately admit that, despite the association, the effect size on these relatively rare events is small and not enough to refuse operation to active smokers.[6] The trend continues to be larger and larger cohorts with similar findings.

Finally, the 2017 NSQIP study by Borad et al[9] is most similar to ours. They performed a propensity matched–analysis of > 32,000 ventral hernia repair patients in each group. Although the study had some differences in their definitions (current smokers defined as those smoking within 1 year of operation), control group (former *and* never smokers) and inclusion of laparoscopic and contaminated cases, some results are still comparable. The overall 30-day morbidity rates of current smokers compared with former and never smokers in that NSQIP study was 7.2% vs 5.4% ($P < .0001$), which is relatively similar to our 30-day morbidity rates of 7.5% vs 6.6% ($P = .60$).[9] Regarding all wound morbidity specifically, the authors report rates of 4.6% vs 3.1% compared with our SSO findings of 12.0% versus 7.4% in smokers versus nonsmokers.[9] Although the 18%–19% of laparoscopic cases in the NSQIP study may have decreased their wound morbidity rates, our greater rates give a measure of reassurance that the morbidity rates in our data are not under-reported. Of interest, Borad et al[9] do not specifically include SSI in their multivariate analysis, even though it was reported in univariate analysis, which could also indicate a reporting bias. Again, it is important to emphasize that all of the aforementioned multivariate analyses from NSQIP used to generate statistically significant odds ratios are not able to adjust for operative variables and hernia characteristics that likely play a major role in adjusting for morbidity.[14]

Alternatively, some may contend that this retrospective analysis is obsolete because several RCTs have already demonstrated the benefits of short-term preoperative cessation of smoking. Close review of the available RCTs, however, shows the results are either not directly comparable or not that contradictory to our own findings. The study by Lindström et al,[7] which evaluated the effectiveness of smoking cessation 4 weeks before operation, grouped 38 primary hernia repairs with 27 laparoscopic cholecystectomies and 37 orthopedic procedures. Their results did not show a statistical difference in wound infection or wound complication rates but did show a decrease in overall complication rates for those counseled to stop smoking (21% vs 41%, $P = .03$). Review of this data, however, proves it is not possible to assess the morbidity specifically for the hernia repairs.[7] Sørensen et al[15] prospectively attempted a tiered approach to preoperative counseling on smoking cessation specifically before elective hernia repair and found that more aggressive counseling led to cessation rates as great as 64% (defined as decreased smoking or complete cessation); however, there were still no documented differences in wound infection rates. The same group also evaluated the effectiveness of more short-term (2–3 week) smoking cessation before colorectal surgery and again found no difference in overall complication rates.[16]

The most compelling case for cessation of preoperative smoking comes from Møller et al[8] who studied the effectiveness of smoking cessation 6–8 weeks preoperatively and found a dramatic decrease in overall complications (52% vs 18%, $P = .0003$), wound complications (31% vs 5%, $P = .001$), cardiovascular complications (10% vs 0%, $P = .08$), and reoperation (15% vs 4%, $P = .087$) for those counseled to quit smoking (89% success rate). In this study, all operations were orthopedic procedures in Denmark, with median hospital stays of 11–13 days.[8] We would contend that it is impossible to extrapolate these findings specifically to a modern cohort of elective clean OVHR. Although the retrospective nature of our study can only aspire to show a correlation of active smoking with postoperative events, the propensity matching–approach is the best we can do to mitigate the confounding factors inherent to any retrospective review. Although a future randomized trial could potentially account for confounders not measured by the AHSQC, the power of the study required to show a causal relationship of likely small and probably clinically unimportant differences seems like it would be futile based on this data.

To be clear, we do not necessarily challenge the findings of other analyses, merely the conclusions. In fact, our group has traditionally viewed active smoking as an almost absolute contraindication to elective OVHR. In our analysis, current smokers had a 4.6% increase in SSO, based on increased rates of wound cellulitis and seroma, with almost no difference in SSI rates. As a whole, we find this to be clinically unimportant, and, after reviewing the available literature, we would challenge the widely held belief that active smoking has a dramatic impact on wound morbidity, specifically in the context of open clean cases. Again, as tens of thousands of patients in the AHSQC are accrued, these subtle 1%–2% differences will likely become statistically significant, as they have in larger NSQIP studies and Sørensen's meta-analysis,[3–6,17] but statistical significance alone should not be synonymous with clinical importance. Ultimately, surgeons are tasked with interpreting what is clinically meaningful for their patients.[10] Furthermore, surgeons should follow their own outcomes to confirm that these findings are replicable in their own practice, particularly if they are to allow patients to smoke. If a particular surgeon finds their outcomes in this context are markedly worse, that surgeon can return to a practice of required smoking abstinence and then re-evaluate the effectiveness of that intervention. In a modern healthcare environment that emphasizes quality metrics, value, and transparency, it is important for surgeons to track their own outcomes by some mechanism.[18] These data, like NSQIP, provide the surgeon with some reference point so that continuous quality improvement can take place in a dynamic environment.

It is important to mention additional limitations of this work. First, we excluded patients designated as "former smoker" or those who quit > 30 days from operation in our original study design to underscore the potential impact of active smoking by comparing with a control group that had never smoked. We felt these comparison arms would demonstrate the most dramatic distinction. Given the subtlety of the findings, we chose not to pursue a subsequent analysis of former smokers. Second, there are notable differences in the propensity matched groups, namely rates of COPD and elevated BMI. Although the differences in mean BMI (31.4 vs 33.3) are arguably clinically unimportant (both considered class I obesity), subsequent meta-analysis confirmed that neither BMI nor COPD had an independent impact on our outcomes of interest. Third, like NSQIP, our follow-up is limited to 30 days and does not necessarily capture complications after the first 30 days postoperatively. Next, we do not have more granular data on the amount of smoking done by patients, and thus our ability to show a dose-response is limited. Another important criticism of this work is our assumption that a 4.6% difference in SSO rates—not requiring an intervention—is clinically unimportant. Although our experience is that patients with wound cellulitis and seromas not requiring an intervention are managed typically by reassurance in the outpatient setting, with relatively little resource utilization, it is possible that these patients have increased anxiety or decreased satisfaction, and these findings may lead to the consumption of more resources (ie, emergency room visits, recurrent office visits, phone calls, etc). Currently there is no evidence to suggest that SSOs not requiring an intervention cause any of the aforementioned concerns, and as such, we maintain that they are clinically unimportant. Finally, it is important to re-emphasize that these are clean, open cases, and these findings cannot be extrapolated to more complex operative scenarios, particularly in the presence of contamination.

It is critical to mention that surgeons should not view these results with tunnel vision, solely focused on 30-day postoperative morbidity. As physicians, all surgeons should encourage smoking

cessation for the myriad health benefits in regard to cardiovascular and pulmonary disease, as well as a decrease in cancer risk.[19,20] The aforementioned RCT data by Møller et al[8] and Sørensen et al[15] showed success rates as great as 89% with preoperative counseling. Perhaps the preoperative window provides a moment of clarity for patients who need motivation to quit smoking, and small postoperative benefits should be framed appropriately to support this ambition. Furthermore, these data do not address the potential impact of active smoking on hernia recurrence, which is the ultimate determinant of repair success.[21] How are these competing interests reconciled in our future practice? Today, we continue to tell patients that preoperative smoking cessation is a requirement before OVHR; however, given the findings in this report, we no longer cancel a case if the patient admits on the day of surgery they have continued to smoke or "cheat," and we will continue to analyze these data annually.

In conclusion, active smoking before an elective OVHR in a CDC class I wound has a clinically negligible impact on postoperative wound morbidity and all 30-day morbidity. Surgeons allowing perioperative smoking should monitor their outcomes to assure these findings are replicable in their own practice. Continuing to capture such data will one day provide insight into the impact of smoking on long-term outcomes like recurrence.

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