Association of Smoking When Combined with Other Risk Factors on the Incidence of Recurrent Incisional Hernias and Postoperative Surgical Site Infection

Dr. Robert J. Fitzgibbons, Dr. Ryan Walters, Nicholas K. Larsen, Matthew J. Reilly, Dr. Molly Olson, and Dr. Thomas Stewart
Faculty Disclosure

- Ad Hoc Paid Consultant (In the last year)
  - None

- Retainer
  - None

- Speaker's Bureau
  - None

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  - None

- Fellowship Support
  - None

- Financial interest (↑ $10,000 US)
  - None

- Royalty
  - None

- I will not Discuss Off Label Use of Products
Smoking Facts

• Leads to Disease and Disability and Harms Nearly Every Organ of the Body
• Leading Cause of Preventable Death
• The Tobacco Industry Spends Billions of Dollars Each Year on Marketing Cigarettes
• Smoking Costs the United States Billions of Dollars Each Year
• States do not Spend Much of the Money They Get From Tobacco Taxes and Lawsuits to Prevent Smoking and Help Smokers Quit. CDC Recommends That States Spend 12% of Those Funds on Tobacco Control
• Thousands of Young People Start Smoking Cigarettes Every Day
• Many Adult Cigarette Smokers Want To Quit Smoking
Smoking Facts

- Smoking is an Independent Predictor of Postoperative Complications Across a Variety of Surgical Procedures
- Health Care Costs are Higher in Current Smokers
37.8 Million Individuals (15.5% of the Adult US Population) Continue to Smoke
Metastatic Emphysema

A Mechanism for Acquiring Inguinal Herniation

DONALD J. CANNON, PH.D., RAYMOND C. READ, M.D., F.A.C.S.

Since our previous work had indicated that veterans with inguinal herniation demonstrated qualitative and quantitative changes in connective tissue, we tested the hypothesis that a possible mechanism for the defect was chronic exposure to circulating proteases generated in the lung by cigarette smoke. We investigated 59 men (average age: 60 years) with either primary direct or indirect hernias. Most of the patients smoked. Circulating serum elastolytic activity was significantly greater in patients with direct hernias who smoked when compared with controls (p < 0.001). In addition, the serum alpha-1-antitrypsin inhibitory capacity was significantly lower in this category than controls (p < 0.001). Patients with indirect defects who smoked also had significantly higher elastolytic values but to a lesser degree (p < 0.01). Serum antiprotease and protein concentrations were within the normal range in all categories. Our results indicate that an imbalance between blood proteases and antiproteases, resulting from chronic smoking can damage connective tissue in the groin as well as the lung.

From the Veterans Administration Medical Center, Departments of Surgery and Biochemistry, University of Arkansas for Medical Sciences, Little Rock, Arkansas

Attempts to refute Russell’s ideas, those of Keith in 1923, and Harrison the previous year, were soon ignored. The former had written, “We are so apt to look on tendons, fascial structures and connective tissues as dead, passive structures. They are certainly alive, and the fact that hernias are so often multiple in middle-aged and old people leads one to suspect that a pathologic change in the connective tissues of the belly wall may render certain individuals particularly liable to hernia.” Harrison, in 1922, stated:

When we consider the dozens and hundreds of men


American Surgical Association,
• Toxic compounds such as nicotine, carbon monoxide, and hydrogen cyanide results in tissue hypoxia and decreases neutrophils disrupting early wound healing
  • Reduces oxygen tension in tissues and impairs collagen homeostasis
  • Diminished collagen synthesis shown in smokers

• Reduces oxygen tension in tissues and impairs collagen homeostasis
• Decreased fibroblasts and resulting disruption in initial collagen deposition
• Diminished collagen synthesis shown in smokers
The effect of smoking on 30-day outcomes in elective hernia repair

John O. DeLancey a,b, Eddie Blay Jr. a, D. Brock Hewitt a, Kathryn Engelhardt a,d, Karl Y. Bilimoria e, Jane L. Holl f, David D. Odell a, Anthony D. Yang g, Jonah J. Stulberg h,i

a Surgical Outcomes and Quality Improvement Center, Department of Surgery and Center for Healthcare Studies, Feinberg School of Medicine and Northwestern Medicine, Northwestern University, Chicago, IL, USA
b Department of Urology, Northwestern Feinberg School of Medicine, Northwestern University, Chicago, IL, USA
c Center for Healthcare Studies, Feinberg School of Medicine and Northwestern Medicine, Northwestern University, Chicago, IL, USA
d Department of Surgery, Medical University of South Carolina, Charleston, SC, USA

e Department of Surgery, Feinberg School of Medicine and Northwestern Medicine, Northwestern University, Chicago, IL, USA

Methods

• 220,629 Patients Elective Incisional, Inguinal, Umbilical, or Ventral Hernia Repair From 2011 to 2014
• Any Patient who had Smoked Within a Year of Surgery Were Classified as a “Current Smoker”
• 30-day Postoperative Outcomes, Adjusting for Demographics and Comorbidities

Results

- **Current Smokers Experienced ↑ Likelihood of:**
  - Reoperation (OR 1.23 [95% CI 1.11e1.36])
  - Readmission (OR 1.24 [95% CI 1.16e1.32])
  - Death (OR 1.53 [95% CI 1.06e2.22])

- **In Addition, Smokers Experienced ↑ Risk of Postoperative Pulmonary, Infectious, and Wound Complications**

- **No Increased Risk of Postoperative Cardiac or Thromboembolic Events**
The effect of tobacco use on outcomes of laparoscopic and open ventral hernia repairs: a review of the NSQIP dataset

John C. Kubasiak, Mackenzie Landin, Scott Schimpke, Jennifer Poirier, Jonathan A. Myers, Keith W. Millikan, Minh B. Luu

Methods

• ACS-NSQIP Dataset, 72,350 patients

• Open or Laparoscopic Ventral Hernia Repairs, 2009–2012

• Three Groups
  • Never Smoked
  • A History of Ever Smoking
  • Current Smoker = Within The Prior 12 Months
Results

• **Current Smokers: ↑Respiratory** ($P = 0.0003$) and Infectious Complications ($P < 0.0001$)
  • Logistic Regression: Controlling For Sex, Age, Type Of Surgery
    • ↑ Respiratory Complications
      • Pneumonia ($P < 0.0001$)
      • Re-intubation ($P < 0.0001$)

• **Similar Associations Were Seen On Logistic Regression If a Patient Ever Smoked**
  • Pneumonia ($P < 0.0001$)
  • Re-intubation ($P < 0.0001$)
  • Failure to Wean ($P < 0.0001$).

Impact of modifiable comorbidities on 30-day wound morbidity after open incisional hernia repair

Hemasat Alkhatib, MD, Luciano Tastaldi, MD, David M. Krpata, MD, Clayton C. Petro, MD, Li-Ching Huang, PhD, Sharon Phillips, MSPH, Aldo Fafaj, MD, Steven Rosenblatt, MD, FACS, Michael J. Rosen, MD, FACS, Ajita S. Prabhu, MD, FACS

\*Center for Abdominal Core Health, Digestive Disease and Surgery Institute, The Cleveland Clinic Foundation, Cleveland, OH
\^Department of Biostatistics, Vanderbilt University Medical Center, Nashville, TN
Study Population

- 18,907 Incisional Hernia Repairs, 2013 - 2017
  - Inclusion Criteria
    - Elective
    - Synthetic Mesh
    - Wound Class I
  - Exclusion Criteria
    - Parastomal Hernias
    - Presence of a Stoma
    - Primary Hernias
- 3,908 Subjects
  - 32.1 Average BMI
  - 21% DM
  - 9% Smokers

Methods

- **Groups Arbitrarily Defined: Those With 0, 1, or 2+ Modifiable Comorbidities (MCM)**
  - Diabetes
  - Obesity
  - Smoking

- **Primary Outcomes Included**
  - SSO
  - SSI
  - SSOP
Results

- DM, Obesity and Smoking Cumulatively ↑ the Risk of Wound Morbidity
- ↑ # of MCMs Makes it More likely That a Procedural Intervention Will be Required for Management.
- SSPI Most Evident in Patients With All Three Comorbidities and Obese Patients with Diabetes
Conclusion

Patients with DM, Obesity and Smoking Should Receive Exhaustive Counseling on the Effect Their Health Status Has On Their Postoperative Recovery and the Potential Benefit of Preoperative Optimization
Our Study

• Association of Nicotine Use When Other Risk Factors were Mathematically Adjusted to Equalize Groups So That Only Nicotine Use Was Examined

• Nicotine was stratified into:
  • Never
  • Former > 1 year
  • Former < 1 year
  • Current

• Outcomes Were Recurrence at 30 Day and Long Term; 30 Day Incidence of SSO, SSI, SSI Requiring Re-operation( SSOPI), SSI Requiring Treatment, Readmission Rate
Our Population

- AHSQC Repairs* 54273
- Inguinal hernia 27412
- Mesh not used 4293
- Non-incisional 7814

Study population 14754

* As of 2019-09-12
Methods and Materials

• Recurrence Rates Compared at 30 Days and Long Term
• SSO’s Compared At 30 Days
  • SSI
  • SSO Requiring Treatment
  • SSO Requiring a Procedure (SSOPI)
• Results Were Analyzed in Relationship to Patient Demographics Including Height and Weight, Size of the Hernia Defect, Size of the Prosthesis Used To Correct It and Co-morbid Conditions Such as COPD, Diabetes, Steroid Use And Others Which Are Routinely Collected in the Database
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Note. Data presented as median [IQR] or percent.
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</table>

**Note.** Data presented as median [IQR] or percent.
# Recurrence

<table>
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<tr>
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<th>Never (N=8789)</th>
<th>Former (&gt; 1 Year) (N=3475)</th>
<th>Former (&gt; 1 Year) (N=810)</th>
<th>Current (&lt; 1 Month) (N=1589)</th>
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<tbody>
<tr>
<td><strong>30 Day Recurrence</strong></td>
<td>28</td>
<td>9</td>
<td>1</td>
<td>5</td>
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<tr>
<td><strong>1 Year Recurrence</strong></td>
<td>873 (1%)*</td>
<td>342 (1%)*</td>
<td>98 (12%)*</td>
<td>125 (8%)*</td>
</tr>
</tbody>
</table>

* Raw Data
Statistical Analysis Plan (SSO)

- Outcomes
  - Risk of recurrence was estimated using a multivariable Cox proportional-hazards model
  - SSO/SSI was estimated using a multivariable logistic regression model

- “Multivariable”
  - We estimated unique differences between smoking statuses after adjusting for important patient characteristics
  - Age, sex, race, BMI, HTN, DM, COPD, functional status, hernia width, and planned concomitant procedure

- “Cox proportional-hazards model”
  - Estimates a hazard ratio (HR) between smoking status groups
  - Recurrence risk was constant following surgery (verified statistically)

- “logistic regression model”
  - Estimates an odds ratio (OR) between smoking status groups
Statistical Analysis Plan (SSO)

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• “logistic regression model”
  • Estimates an odds ratio (OR) between smoking status groups

Taken together, both the hazard and odds ratios directly compare two patients with different smoking statuses who are identical on all other patient characteristics
Former smokers who quit <1 year ago had 26% higher risk of recurrence compared to those who never smoked as well as those who quit >1 year ago.
- Any previous or current history of smoking was associated with greater odds of SSO compared to those who never smoked.
**Smoking Status Comparison**

<table>
<thead>
<tr>
<th>Comparison</th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current vs. Never</td>
<td>1.04 (0.77-1.41)</td>
<td>0.798</td>
</tr>
<tr>
<td>Former (&lt;1 Year) vs. Never</td>
<td>1.45 (1.04-2.02)</td>
<td>0.028</td>
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<tr>
<td>Former (&gt;1 Year) vs. Never</td>
<td>0.94 (0.75-1.18)</td>
<td>0.591</td>
</tr>
<tr>
<td>Current vs. Former (&lt;1 Year)</td>
<td>0.72 (0.48-1.08)</td>
<td>0.112</td>
</tr>
<tr>
<td>Current vs. Former (&gt;1 Year)</td>
<td>1.11 (0.79-1.54)</td>
<td>0.548</td>
</tr>
<tr>
<td>Former (&lt;1 Year) vs. Former (&gt;1 Year)</td>
<td>1.54 (1.07-2.20)</td>
<td>0.020</td>
</tr>
</tbody>
</table>

**Adjusted Odds Ratio with 95% CI**

- Former smokers who quit <1 year ago had 45% and 54% greater odds of SSI compared to those who never smoked as well as those who quit >1 year ago.
### SSI Requiring Reoperation

<table>
<thead>
<tr>
<th>Smoking Status Comparison</th>
<th>OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current vs. Never</td>
<td>1.17 (0.91-1.50)</td>
<td>0.221</td>
</tr>
<tr>
<td>Former (&lt;1 Year) vs. Never</td>
<td>1.50 (1.13-2.00)</td>
<td>0.005</td>
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<tr>
<td>Former (&gt;1 Year) vs. Never</td>
<td>1.16 (0.96-1.39)</td>
<td>0.124</td>
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<tr>
<td>Current vs. Former (&lt;1 Year)</td>
<td>0.78 (0.55-1.10)</td>
<td>0.163</td>
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<tr>
<td>Current vs. Former (&gt;1 Year)</td>
<td>1.01 (0.77-1.33)</td>
<td>0.943</td>
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<tr>
<td>Former (&lt;1 Year) vs. Former (&gt;1 Year)</td>
<td>1.30 (0.96-1.76)</td>
<td>0.090</td>
</tr>
</tbody>
</table>

- Former smokers who quit <1 year ago had 50% greater odds of SSI required reoperation compared to those who never smoked.
• Former smokers who quit <1 year ago had 30% greater odds of SSI requiring treatment compared to those who never smoked
Conclusion
Conclusion

• There is an Association at the 0.05 Level Between Nicotine Use and
  • 30-day Surgical Site Occurrence (SSO)
  • 30-day Surgical Site Occurrence Requiring Procedural Intervention (SSOPI)
  • 30-day Readmission (Data Not Shown)

• We did not Demonstrate a Significant Difference Between Recurrence Rates Across Groups but the Numbers are Small

• The Association Between Nicotine Use And Other Surgical Outcomes is Inconclusive
Society for Perioperative Assessment and Quality Improvement (SPAQI) Consensus Statement on Perioperative Smoking Cessation

Jean Wong, MD,*† Dong An, BMSc,* Richard D. Urman, MD, MBA;‡ David O. Warner, MD;§
Hanne Tønnesen, MD, PhD,¶¶ Ravira Raveendran, MBBS,# Hairil R. Abdullah, MBBS,**
Kurt Pfeifer, MD, FACP SFHM,††⁺⁺ John Maa, MD,§§§§ Barry Finegan, MD,¶¶
Emily Li, BScPharm, PharmD,## Ashley Webb, MBBS, MPH,***+++ Angela F. Edwards, MD,+++,
Paul Preston, MD, §§§ Nathalie Bentov, MD, MA,|||–––
Deborah C. Richman, MBChB,+++## and Frances Chung, MBBS*

Key Statements

• Longer Durations of Preoperative Abstinence are Associated With Lower Rates of Respiratory and Wound Complications

• 4- to 8 Weeks Ideal Long but Shorter Duration Does not Complication Rates

• High-intensity Perioperative Smoking Cessation Programs Combined with Self-help Products, Tobacco Quit Lines, Text Messaging Systems and Pharmacotherapy Most Effective

• A Substantial Number of Perioperative Patients Will Quit Permanently

The End