

# Recommendation of Smoke Free Surgery



医療者の知られざる健康被害  
5分間のモノローグ



「笑い」があれば長生きできると、日本医師会前会長の高久史磨先生は、「ユーモア」の大切さを語られています。「笑い」は血糖値や血圧を下げる効果もあるようです。

併せて、一日に一万歩のウォーキング、過食を避け、野菜を多めに摂ることなども健康法に挙げられています。

過度の飲酒や喫煙などは、無論、ご法度。医者の不養生とならないためにも健康に留意しなければなりません。

一方、医療現場で見過ごされているのが、レーザーや電気メスの焼灼時に生成される煙やプリュームの危険性です。

診療時に医師が直面するリスクにつきまとめました。



### 化学物質<sup>1),2),3),4)</sup>

ペルクロロエチレン、シアン化水素、エチルベンゼン、ホルムアルデヒド、トルエン、一酸化炭素など27種以上の有害化学物質。一酸化炭素に限れば、手術室勤務者は、一日平均タバコ27本～30本の喫煙に相当するリスクにさらされているとの報告がある。



### 感染性微生物<sup>5),6),7),8),9)</sup>

生成されるサージカルスモークの95%は水分であり、蒸散された血液や、HIV-1などの感染性ウィルスや細菌が存在するとの報告がある。



### 呼吸域物質<sup>10),11),12)</sup>

0.01 ミクロン以上、200ミクロン未満の粒子。その大部分が0.3～0.5ミクロンの大きさであり、0.3ミクロン以下の粒子は肺胞まで達し、COPD、肺気腫 ぜんそくの増悪などの原因となる。

## Bibliography:

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<sup>3)</sup>Tackle Toxic Surgery Smoke Risk for Doctors, Nurses, Patients

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<sup>4)</sup>Study of Health Care Workers Shows Prevalence of Surgical Smoke Exposure

Andrea Steege; Safety and Health Magazine; 11/2015.

<sup>5)</sup>Surgical Smoke and the Dermatologist

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<sup>6)</sup>Surgical Smoke and Infection Control

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<sup>7)</sup>BViral Disease Transmitted by Laser-Generated Plume (Aerosol)

Jerome M. Garden, MD; M.Kerry O'Banion, MD; PhD, Abnoeal D. Bakus, PhD; Carl Olson, DVM, PhD; Archives of Dermatology, Vol 138; 10/2002.

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<sup>9)</sup>OMaximizing Surgeon Safety During Excimer Laser Photorefractive Procedures

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<sup>10)</sup>Pilot Study of Directional Airflow and Containment of Airborne Particles in the Size of Mycobacterium Tuberculosis in an Operating Room

Russell N. Olmsted, MPH, CIC; American Journal of Infection Control, Vol 36, No 4; 5/2008.

<sup>11)</sup>Surgical Smoke and Ultrafine Particles

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Michael J. Taravella, MD; EyeWorld, Vol 6, No 6; 6/2001.



# Regulations, Recommended Practices & Standards

## Occupational Safety & Health Administration (OSHA)

OSHA is the only U.S. regulatory body to date that has legal authority in the United States granted by Congress. They estimate that 500,000 healthcare workers are exposed to surgical smoke and bio-aerosols each year. On a number of occasions OSHA has reiterated that the management of surgical plume is a healthcare worker safety issue.

### **Association of periOperative Registered Nurses (AORN)**

AORN is a professional association based in Denver, Colorado that represents the interests of more than 160,000 perioperative nurses.

The following are contained in Recommended Practices:

#### **2017 AORN Guideline for Surgical Smoke Safety**

##### **Recommendation I**

"The health care organization should provide a surgical smoke free environment."

##### **Recommendation II**

The perioperative team should evacuate all surgical smoke. "The collective evidence, standards, and guidelines from NIOSH, the Healthcare Infection Control Practices Advisory Committee, and professional organizations indicates that evacuating surgical smoke protects patients and health care workers from the hazards of surgical smoke."

##### **Recommendation III**

"Perioperative team members should receive initial and ongoing education and competency verification on surgical smoke safety."

##### **Recommendation IV**

"Policies and procedures for surgical smoke safety should be developed, reviewed periodically, revised as necessary, and readily available in the practice setting in which they are used."

##### **Recommendation V**

"Perioperative personnel should participate in a variety of quality assurance and performance activities that are consistent with the health care organization's plan to improve understanding and compliance with the principles and processes of surgical smoke safety."



## NIOSH Hazard Controls HC11

サージカルスモークやブリュームにはベンゼンやシアン化水素などの有毒ガスや蒸気が含まれ、血液片などの細胞物質やウィルスが存在することが調査研究で**確認されている。**

NIOSHの研究で手術機器により生成された空中浮遊汚染物質は効果的に制御できることが明らかになっている。二つの制御法が推奨される。

医療現場での主な換気法とは、医療者へのサージカルスモークの暴露レベルを減らすための方法であり、移動可能な吸煙器、室内の排気システムの二つである。

一般的に、非内視鏡的なレーザーや電気メス手術で生成される煙を制御するには、室内の排気システムよりも、**吸煙器を使う方が、より効果的**といえる。

**HAZARD**

During surgical procedures using a laser or electrothermal unit, the thermal destruction of tissue creates a smoke byproduct. Research studies have confirmed that this smoke plume can contain toxic gases and vapors such as benzene, hydrogen cyanide, and formaldehyde, hexamethyldisiloxane, and fine cellular material including blood fragments, and spores. At high concentrations, the smoke causes visible and upper respiratory tract irritation to health care personnel, and creates visual problems for the surgeon. The smoke has significant odors and has been shown to have mutagenic potential.

**CONTROLS**

NIOSH research has shown airborne contaminants generated by these surgical devices can be effectively controlled. Two methods of control are recommended:

- **VENTILATION**

Recommended ventilation techniques include a combination of general room and local exhaust ventilation (LEV). General room ventilation is not by itself sufficient to capture contaminants generated at the source. The two major LEV approaches used to reduce surgical smoke levels for health care personnel are portable smoke evacuators and room suction systems.

Smoke evacuators contain a suction unit (vacuum pump), filter, hose, and an inlet nozzle. The smoke evacuator should have high efficiency in airborne particle reduction and should be used in accordance with the manufacturer's recommendations to achieve maximum efficiency. A capture velocity of about 100 to 150 feet per minute at the inlet nozzle is generally recommended. It is also important to choose a filter that is effective in collecting the contaminants. A High Efficiency Particulate Air (HEPA) filter or equivalent is recommended for trapping particulates. Various filtering and cleaning processes also exist which remove or inactivate airborne gases and vapors. The various filters and absorbers used in smoke evacuators require monitoring and replacement on a regular basis and are considered a possible biohazard requiring proper disposal.

Room suction systems can pull at a much lower rate and were designed primarily to capture liquids rather than particulates or gases. If these systems are used to capture generated smoke, users must install appropriate filters in the line, ensure that the line is cleared, and that filters are disposed properly. Generally speaking, the use of smoke evacuators are more effective than room suction systems to control the generated smoke from nonendoscopic laser/electric surgical procedures.

国立労働安全衛生研究所による、有毒物質が確認されているので除去すべきとの勧告。  
(National Institute of Occupational Safety and Health, NIOSHA)



## Australian College of Operating Room Nurses (ACORN)

### Standard S20

- Personnel shall utilize appropriate equipment and procedures to prevent exposure to surgical plume
- Exposure to surgical plume shall be minimized during the surgical procedure
- Surgical smoke capture devices shall be available for use during procedures in which surgical smoke is generated (ACORN 2006)



## Canadian Standards Association (CSA)

CSA Z305.13-13 Plume Scavenging In Surgical, Diagnostic, Therapeutic, and Aesthetic Settings

- Facility policies and procedures shall be written in accordance with (IAW) this Standard.
- Plume shall be evacuated IAW this standard.
- If a facility employs techniques that create plume, they shall have policies that address the potential hazards.



## Danish Working Environment Authority

AT-Instructions 4/2007 and 11/2008

- It is mandatory to implement a measurable setup for local evacuation of harmful substances, such as surgical smoke.
- Such a setup must be equipped with a monitoring feature to indicate if the evacuation system's suction is inadequate.
- Surgical smoke should be removed with local evacuation and as close to the source as possible.
- The filtered air must lead out into the open (read: outside the OR).



## Medicines and Healthcare Products Regulatory Agency (MHRA)

MHRA DB2008(03) April 2008

- Recommends that smoke evacuation systems are to be used during laser surgery. In addition, it is specified that masks and operating room laminar flow systems are not suitable for protection from surgical smoke.

## Association for Perioperative Practice (AfPP)

Standard 2.6 Lasers - Standards and Recommendations for Safe Perioperative Practice

- States that 'Dedicated smoke evacuation machines must be used to remove the smoke...' (AfPP 2007).AT-Instructions 4/2007 and 11/2008
- It is mandatory to implement a measurable setup for local evacuation of harmful substances, such as surgical smoke.

## 日本手術医学会実践ガイドライン

1-4 生体組織の焼灼時に発生する煙霧の毒性を考慮し、患者と手術スタッフが手術中に発生する煙を吸入しないように、排煙システムで屋外に強制的に排気することが望ましい。日本手術医学会実践ガイドライン

【解説】 電気メスの切開・凝固により、手術野から発生する煙霧は、大気中に有害な窒素酸化物を含むため、患者や手術スタッフが煙霧を直接吸うことは望ましいことではない。また、感染疾患患者の煙霧内にウイルスのDNAの存在の危険性も指摘されているが、感染の危険性については、針刺し切創などの血液感染と比べて感染の確率は極めて低いと考えられる。

サージカルスモークの危険性を重視し、レーザーや電気メスの使用時に吸煙器の使用を義務付けてきたデンマーク、スウェーデンに続き、2019年春から米国でもコロラド州、ロードアイランド州でも吸煙器使用が法制化されました。焼き肉などとは異なる焼灼温度で発生するサージカルスモークを避けようとするのは、当然であり、危険物質が生成され、感染性があることは厳然たる事実です。

サージカルスモークを無臭化するだけではなく、ULPAフィルタを透過させ、完全に無害化する吸煙器こそ、これからの医療現場に必要とされています。

欧米では吸煙器は医療機器として、FDA認証やCEマークが必要なデバイスとなっております。

排出される空気が完全に清浄化され、安心して診療ができる製品をお勧めします。