

What is Surgical Smoke?

Surgical smoke is a dangerous by-product generated from the use of lasers, electro-surgical pencils, ultrasonic devices, and other surgical energy based devices. As these instruments cauterize vessels and destroy (vaporize) tissue, fluid, and blood, a gaseous material known as surgical smoke is created. It is estimated that approximately 95% of all surgical procedures produce some degree of surgical smoke.

Why is Surgical Smoke so Hazardous?

The composition of surgical smoke is generally 95% water and 5% other matter. It is the other matter that is hazardous to surgical personnel and patients. The hazards of surgical smoke can be broken down into chemical, biological and physical components.

The *chemical* component of surgical smoke contains over 80 different toxic chemicals and by-products; some which have documented harmful health effects. Some of the chemicals that have been identified are:

- Perchloroethylene: main component in dry cleaning fluid
- Hydrogen cyanide: neurotoxin used in chemical warfare
- Toluene: similar to paint thinner; known carcinogen
- Formaldehyde: used to preserve surgical specimens and embalming fluid
- Ethylbenzene: used in the manufacture of Styrofoam
- Benzene: known carcinogen

The carbon monoxide generated during electrocautery can cause headaches and nausea, and be undetected by pulse oximetry. Surgical smoke and aerosols irritate the lungs and have similar mutagenicity of cigarette smoke.¹ A recent study done to quantify exposure found that on average the surgical produced daily in the operating room was equivalent to 27-30 cigarettes.² These compounds pose a health risk to exposed OR staff and patients.

The *biological* matter is the particulate matter of the surgical smoke that contains blood, and potentially infectious viruses and bacteria. Since surgical smoke is comprised of approximately 95% water vapor it creates a viable carrier for bacteria and virus which can transfer infectious diseases. There is documented evidence of virus being transferred airborne with surgical smoke. One report from a surgeon indicates he contracted the same DNA viral type of HPV in his larynx as a patient he had recently treated for anogenital condylomas.³ Evidence has also been found of HIV-1 in surgical smoke caused by powered surgical instruments.⁴

The *physical* components consist of particulate from surgical smoke that ranges from <0.01 microns to >200 microns with a majority between .3 to .5. These ultrafine particles are significantly elevated in the operating theatre and create a very fine dust similar to coal dust when electrocautery devices are used. Particles smaller than .3 microns can bypass the lungs normal filtration mechanisms, the mucus secretions and cilia, and deposit in the alveoli, where the exchange of blood/gas takes place. In addition, surgical smoke is consistent with cigarette smoke in that it can paralyze the cilia. It has been shown that surgical smoke can induce acute and chronic inflammatory changes including congestion, pneumonia, bronchiolitis and emphysematous changes in the respiratory tract.⁵

Why Evacuate It?

Besides mitigating the risks associated with the physical, chemical, and biological components of surgical smoke, there are several reasons to evacuate it including:

- Surgical smoke creates visibility difficulty during minimally invasive procedures and procedures where there is a lot of tissue ablation slowing down surgical time and potentially increasing the risk for complications
- Removal of aerosols in the peritoneal cavity have shown to help reduce build up on camera lenses
- Medical staff have reported a number of symptoms associated with exposure to surgical smoke including nausea, headaches, sneezing, lightheadedness, dizziness, eye/nose/throat irritation.⁶
- Surgical smoke has shown the potential to have adverse negative effects on the patient when surgical smoke is not properly evacuated during laparoscopic/ endoscopic procedures.⁷ During laparoscopic surgery toxic compounds present in surgical smoke are absorbed into the body.⁸

Bibliography:

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⁶SCHUCO International. Surgical smoke. In: Have You Considered the Danger of Surgical Smoke Plume? Available at: http://www.myelectrosurgery.co.uk/resources/Dangers_of_Smoke_Plume_final.pdf. Accessed February 1, 2011.

⁷Ott DE. Safety concerns in endoscopy. Presented at International Society of Lasers in Medicine and Surgery November 5, 1991. *Plume facts 2 1991; (Fourth Quarter): 3-4*

⁸Dobrogowski M, Wesolowski W, Kucharska M, Sapota A, Pomorski LS (2014) Chemical composition of surgical smoke formed in the abdominal cavity during laparoscopic cholecystectomy - Assessment of the risk to the patient. *Int J Occup Med Environ Health* 2014 Apr 9. Epub 2014 Apr 9.