

## Editorial

### Surgical Smoke

*Luis Carlos Romero Quezada<sup>a</sup>*

Personnel working in hospital centers are exposed to various dangerous substances, such as smoke, vapors, dust or particles that can damage their health.<sup>1-3</sup> It is also important to consider constant exposure to pathogenic microorganisms or accidents that may occur in the hospital. The risk or damage to health that may result from exposure to hazardous substances includes allergies, skin diseases, cancer, eye damage, respiratory diseases, reproductive problems and congenital malformations, acute poisoning, among others.<sup>1-3</sup>

In the clinical surgical area, the terms "surgical smoke" or "plume" are used to describe the various substances released into the air or closed body space when the tissues are heated to the boiling point by the use of an energy generator device during surgery.<sup>4,5</sup> Surgical smoke is produced by the thermal destruction of tissue by an electrosurgical instrument.<sup>4,5</sup> The health risks of people exposed to surgical smoke have been studied during the last decades. However, due to the high probability that surgical smoke causes health damage, laws related to work safety in the United States have recently been initiated.<sup>6,7</sup>

Surgical smoke contains potentially harmful organic and inorganic particles. The size of the particles that form the surgical smoke can vary, depending on the device used. For example, in electro-surgery the smallest particles (0.1  $\mu\text{m}$ ) are produced, while ultrasonic devices produce the largest particles (0.35-6.5  $\mu\text{m}$ ). This surgical smoke will be produced whenever the devices that generate energy are used during the surgery, therefore actions must be taken to protect patients and personnel participating in the surgery from this exposure.<sup>4,5</sup>

Particles smaller than 5  $\mu\text{m}$  apparently cannot be filtered by surgical masks and can therefore be inhaled.<sup>8</sup> The main harmful substances identified during electro-surgery include: hydrocyanic acid, acetylene, butadiene, toluene, ethylbenzene, xylene, furfural, styrene, acrolein, acetonitrile, benzene, butane, carbon monoxide, ethane, formaldehyde, phenol, propylene, styrene, among others.<sup>8,9</sup> Regarding the presence of microorganisms, viral DNA has been identified in surgical smoke.<sup>10</sup> In addition, viable melanoma cells were found in surgical smoke in experimental animals.<sup>11</sup> Likewise, surgical smoke has been studied during the exeresis of abdominal cancerous tumors, and mesothelial and blood cells have been found intact.<sup>12</sup> However, it has not been demonstrated harmful effects of the latter on the staff performing surgery in clinical studies.

There is abundant evidence of the production of surgical smoke with electrical instruments and the exposure of patients and health personnel, and direct effects on health such as: headache, eye, nose and respiratory irritation, and other chronic and acute pulmonary conditions.<sup>10</sup> In this sense, strategies must be carried out to avoid the contact of health personnel and patients with surgical smoke. Three main strategies have been suggested: the use of mechanical air extractors, evacuators or smoke suckers and the use of efficient surgical masks (N95 or N100) (Figure 1).<sup>7,9,13</sup> Also, it is important to train all the personnel involved in the operation surgeries on the use of masks and to monitor the proper functioning of the direct smoke suckers and the air extractors of the surgical room.



Figure 1. 3M™ Particulate Respirator 8110S, N95 160 EA/Case. 3M™ Particulate Respirator 8233, N100 20 EA/Case.<sup>13</sup>

<sup>a</sup> Corresponding author: Área Académica de Medicina. Instituto de Ciencias de la Salud. Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo. México. Email: [lcromeromedicina@gmail.com](mailto:lcromeromedicina@gmail.com); [lcromeroquezada@hotmail.com](mailto:lcromeroquezada@hotmail.com)

## **References**

1. Gestal JJ. Occupational hazards in hospitals: accidents, radiation, exposure to noxious chemicals, drug addiction and psychic problems, and assault. *Br. J. Ind. Med.* 1987; 44(8): 510–520.
2. Manyele SV, Ngonyani HA, Eliakimu E. The status of occupational safety among health service providers in hospitals in Tanzania. *Tanzan J. Health Res.* 2008; 10(3):159-65.
3. El-Sallamy RM, Kabbash IA, El-Fatah SA, El-Feky A. Physical hazard safety awareness among healthcare workers in Tanta university hospitals, Egypt. *Environ. Sci. Pollut. Res. Int.* 2018;25(31): 30826-30838.
4. Alp E, Bijl D, Bleichrodt RP, Hansson B, Voss A. Surgical smoke and infection control. *J. Hosp. Infect.* 2006; 62(1):1-5.
5. Hazard Controls: Control of smoke from laser/electric surgical procedures. The National Institute for Occupational Safety and Health. 1996. [cited April 16]. Available from: <https://www.cdc.gov/niosh/docs/hazardcontrol/pdfs/hc11.pdf>.
6. Palmerton DR. A look back at 2016 &... moving forward. *Int. Counc. Surg. Plume Newsl.* 2016; 2(1).
7. Ball K. Protecting Patients From Surgical Smoke. *AORN J.* 2018; 108(6):680-684.
8. Mowbray N, Ansell J, Warren N, Wall P, Torkington J. Is surgical smoke harmful to theater staff? A systematic review. *Surg. Endoscopy* 2013; 27: 3100-3107.
9. Bree K, Barnhill S, Rundell W. The Dangers of Electrosurgical Smoke to Operating Room Personnel: A Review. *Workplace Health Saf.* 2017; 65(11): 517-526.
10. Okoshi K, Kobayashi K, Kinoshita K, Tomizawa Y, Hasegawa S, Sakai Y. Health risks associated with exposure to surgical smoke for surgeons and operation room personnel. *Surgery Today* 2015; 45: 957-965.
11. Fan JK, Chan FS, Chu KM. Surgical smoke. *Asian J. Surg.* 2009; 32: 253-257.
12. Spearman J, Tsavellas G, Nichols P. Current attitudes and practices towards diathermy smoke. *Ann. R. Coll. Surg. Engl.* 2007; 89(2): 162-165.
13. 3M Science. Applied to Life.™ 2019. [cited April 16]. Available from: [https://www.3m.com/3M/en\\_US/company-us/all-3m-products/~/3M-Particulate-Respirator-8233-N100-20-EA-Case/?N=5002385+3294776421&rt=rud](https://www.3m.com/3M/en_US/company-us/all-3m-products/~/3M-Particulate-Respirator-8233-N100-20-EA-Case/?N=5002385+3294776421&rt=rud)