Surgical Smoke—Concern for Both Doctors and Patients

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Electrocautery devices, lasers, and ultrasonic scalpels are being increasingly used in operating theaters worldwide and have become a “sine qua non” in modern surgery. Their use despite being widespread is not harmless. These devices produce gaseous by-products usually referred to as “surgical smoke” or plumes which are inhaled by the staff in the operating theater. It is estimated that 90 % of all endoscopic and surgical procedures produce plume and that 350,000 health-care workers are exposed to this in a yearly basis [1]. Energy-based instruments which include electrocautery devices and lasers heat the targeted cells to the point that they start boiling, which causes the cell membrane to rupture. Ultrasonic devices cause cell rupture by using a vibrating plate at a much lower temperature than electrocautery. This simultaneously causes cutting and coagulation without any electrical current being passed through targeted tissue. These processes disperse fine particles into the atmosphere which are inhaled by the OR team and the patient [2].

There have been concerns regarding the infectivity, cytotoxicity, and mutagenicity from the aforementioned devices. Smoke produced by these devices contains mainly hydrocarbons, nitrile, fatty acids, and phenols. Among these, formaldehyde, acrolein, mixtures of benzene, xylene (BTEX), toluene, ethylbenzene, and polyaromatic hydrocarbons are of most concern. These

chemical toxins may cause pulmonary irritation and inflammation of the respiratory tract as these chemicals are known irritants. Polyaromatic hydrocarbons, formaldehyde, and benzene are known carcinogens. The toxicity of plume is estimated to be similar to that of cigarette smoke. Thermal destruction of 1 g of tissue with tissue ablation is calculated to be equivalent to three cigarettes and with electrocautery up to six cigarettes [3].

Surgical smoke in addition to chemical by-products contains harmful viable and nonviable cellular material, which includes blood fragments and viruses. Several cases of transmission of human papilloma virus (HPV) from patient to practitioner have been reported [1]. Viable bacteria including *Neisseria*, *Corynebacterium*, and *Staphylococcus* have also been cultured from surgical smoke [4].

In order to avoid long-term complications, practitioners should be more aware of contents and hazards of plume and take action to lessen the risk to themselves and their colleagues. A surgical mask can, in general, provide more than 90 % protection to exposure to surgical smoke which however, in most circumstances, cannot provide airtight protection to the user, and at least N95 grade or equivalent respirator offers the best protection against surgical smoke. Staff members and patients should be provided with the appropriate safety eyewear for use in the operating theaters to avoid irritation from the smoke. Smoke evacuation devices have been shown to be effective in limiting exposure to the noxious odor and potential health hazards of smoke and plume which however have not been used routinely and consistently in many ORs. We advocate the use of smoke evacuator systems for all practitioners regularly performing these procedures and suggest that further research is required to investigate potential long-term complications to the health worker and the patients.

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