ACORN
AUSTRALIAN COLLEGE OF PERIOPERATIVE NURSES

Position statement on surgical plume

The Australian College of Perioperative Nurses (ACORN) sets the standards for perioperative nurses through the Surgical plume standard and Surgical plume position statement. However, it is the responsibility of health service organisations to implement work health and safety practices which comply with each jurisdiction's work health and safety (WHS) legislation. It is not the responsibility of ACORN to create or implement legislation; however, ACORN will take an active role in setting the standard and, when required, provide consultation to all state jurisdictions on the management of surgical plume to develop and update WHS legislation.

Although ACORN has a standard on surgical plume and an associated position statement, it is the responsibility of state and territory governments to enact occupational health and safety legislation for the protection of perioperative staff against occupational harm within the workplace.

ACORN's position

- Multidisciplinary perioperative teams will work in an environment that eliminates or reduces the risk of exposure to surgical plume.[1,2]
- Health service organisations will comply with state and territory work health and safety legislation to provide perioperative team members with a safe workplace.[1–3]
- Health service organisations will have policies on the management of surgical plume and perioperative team members may refuse to participate in procedures when policies and procedures are not followed.
- ACORN supports and encourages perioperative team members to submit incident reports when plume evacuation is not implemented and to also report adverse health effects they believe arise from exposure to surgical plume.

Background

Surgical plume is produced as a by-product during the use of energy-generating surgical devices including electrosurgical equipment, ultrasonic devices, lasers and high-speed power tools.[4–10] Surgical plume poses a risks to the health and safety of perioperative staff and patients and therefore requires appropriate management to reduce these risks.[5,8,9,11,12]

As tissue is cut and coagulated by energy-generating surgical devices, high temperatures vaporise tissue and fluid creating surgical plume[13] containing fine and ultra-fine particles which can be inhaled by perioperative staff. These particles are created at high velocities and, therefore, have the propensity to spread widely within the operating room. The particles within surgical plume range in size from 0.07µm to 6.5µm, with the smaller particles being the most dangerous as they can penetrate the lungs to the alveolar level and move into the lymphatic and circulatory systems through the process of transcytosis.[5,10,14]

The fine and ultra-fine particles within surgical plume may contain 80 to 150 chemical compounds, including nitriles, benzene, formaldehyde, cyanide, toluene, phenols and toxic gaseous compounds. Some of these compounds are carcinogenic. Additionally, surgical plume may contain bacteria, mycobacteria and dead and alive cellular material, including viable cancer cells, DNA, aerolsolised blood and fatty acids.[6,8,11,15,16] Viruses, such as human papilloma virus (HPV) and human immunodeficiency virus (HIV), as well as lung damaging dust, can also be present in surgical plume.[2,4,15]

The nurmerous harmful substances found within surgical plume may include:

- Polycyclic aromatic hydrocarbons: benzo-[a]anthracene, -[a]pyrebe, -[b]fluroanthede, chrysene/triphenylene, dibenzol[a,h]anthracene, indenol[1,2,3-cd]pyrene, acenaphthene, acenaphthylene, anthracene, benzol[ghi]perylene, phenanthrene, fluoranthene, fluorene, napthalene and pyrene.[4,11,13,17]
- Other chemicals: acetonitrile, acetylene, acroloin, acrylonitrile, alkyl benzene, benzaldehyde, benzene, benzonitrile, butadiene, butene, 3-butenenitrile, carbon monoxide, creosol, 1-decene, 2,3-dihydro indene, ethane, ethyl benzene, ethylene, formaldehyde, furfural, hexadecanoic acid, hydrogen cyanide, indole, methane, 3-methyl butenal, 6-methyl indole, 4-methyl phenol, 2-methyl propanol, methyl pyrazine, phenol, propene, 2-propylene nitrile, pyridine, pyrrole, styrene, toluene, 1-undecene and xylene.[4,6,11,13]
- Biological components: viruses, including hepatitis B, HPV and HIV, blood, bacteria, mycobacteris and cancer cells.[1,4,6,15] Although further research is needed into the potential aerosolisation of the SARS-CoV-2 virus it may also be found in surgical plume.[18]
- Miscellaneous components: lung-damaging dust.[15]

Inhalation of surgical plume can cause nasal congestion, nasopharyngeal lesions, cough, headache and irritation to the nose, throat and eyes. Furthermore, there is a potential risk of transmission of viruses and bacteria to perioperative staff exposed to surgical plume. Surgical plume has been shown to cause acute and chronic inflammatory disease in animal studies including asthma, chronic brochitis, emphysema, alveolar congestion and interstitial pnuemonia. There is an absence of human studies on the carcenogenesis of surgical plume; however, the carcenogenesis of surgical plume has been demonstrated *in vitro* and surgical plume has been compared to cigarette smoke in relation to the potential for causing cancer.[5,12,16]

Recommendations

1. A multidisciplinary approached will be used to evaluate and procure appropriate plume evacuation equipment suitable for the local setting.[4,12,15]
2. The health service organisation and perioperative team should use a hierarchy of controls for the management of surgical plume. These controls include eliminating the hazard, substituting

the hazard, using engineering controls, using administrative controls and wearing personal protective equipment.[1,2,4,15]

3. The decision to evacuate surgical plume will be made by the entire perioperative team and not at the discretion of an individual team member.[4,15]
4. All perioperative team members will receive initial and ongoing education on surgical plume safety and use of plume evacuation equipment.[4,6,7,12]
5. The risk of exposure to surgical plume will be assessed and, if possible, alternative energy-generating devices or surgical techniques should be used.[4]
6. All surgical plume produced will be captured as close to the point of generation as possible, evacuated and filtered using filters capable of 0.1micron filtration with 99.999 per cent efficiency.[1-4,12,15]
7. All surgical plume generated during minimally invasive procedures will be captured and filtered with appropriate plume evacuation equipment.[3,4,16,18]
8. Personal protective equipment will not be used as a replacement for plume evacuation and filtration.[2,4,9]
9. Surgical masks provide ineffective protection against surgical plume; therefore, fitted N95 masks will be used to provide second-line protection against surgical plume.[2,3,5,9,12]

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