2.7 MANAGEMENT OF SURGICAL SMOKE PLUME IN THE PERIOPERATIVE ENVIRONMENT

The following is an extract from ***Standards and Recommendations for Safe Perioperative Practice*** **(Fifth Edition)**, published by the Association for Perioperative Practice.

The hierarchy of control measures

When risk assessments are undertaken, it is the responsibility of the employer to review the findings and to instigate the hierarchy of controls to reduce the risk. This should be done in ascending order from most effective to least effective.

1. Elimination - Physically remove the hazard.
2. Substitution - Replace the material or process with a less hazardous one.
3. Engineering controls - Isolate people from the hazard e.g. use work equipment or other measures to prevent and control risks. Give priority to measures that protect collectively over individual measures. (Operating theatre ventilation at 20 air changes per hour and/or local exhaust ventilation devices used in the surgical field.)
4. Administrative controls - Change the ways people work. These are all about identifying and implementing the procedures you need to work safely. (Policies and procedures, risk assessments, education, and training.)
5. Personal protective clothes and equipment - Protect the worker with personal protective equipment (PPE). Only after all the previous measures have been tried and found to be ineffective in controlling risks to a reasonably practicable level must PPE be used. If chosen, PPE should be selected and fitted by the person who uses it. Workers must be trained in the function and limitation of each item of PPE (HSE 2012).

Evidence

Considerable research over a number of years, mostly from the United States of America (USA), concludes that evidence is sketchy when directly linking surgical plume to added morbidity and mortality in healthcare professionals working in the perioperative environment. However, use of smoke plume evacuation devices is recommended as many of the airborne particles contain carcinogens (Bree et al 2017). Potential harm caused by exposure to electrosurgical smoke plume during cholecystectomy procedures, highlighted concerns as significant levels of benzene and toluene had been recorded in patients' urine (Dobrogowski et al 2014).

The Health and Safety Executive (HSE) (2012) literature review indicated there is not yet sufficient data to formulate evidence based conclusions on reported respiratory ill health symptoms linked to surgical smoke exposure.

However, the HSE (2012) research also concludes that correct, close positioning of smoke plume evacuation devices to source emissions, if not already tip mounted, is likely to be important to the efficiency of surgical smoke plume removal. In addition, it indicates that smoke evacuation devices are effective at reducing the levels of surgical smoke during various surgical procedures, compared to levels when no evacuation system is present.

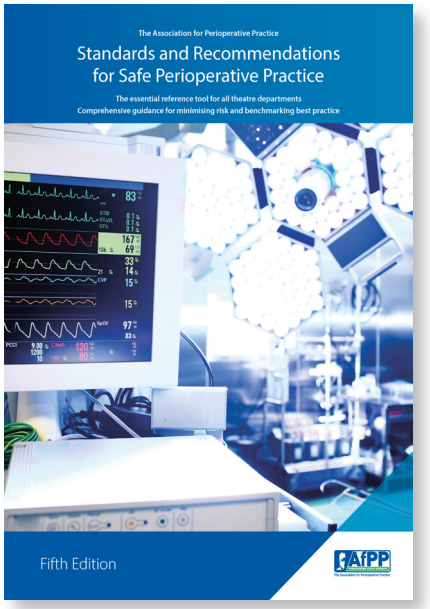
The United Kingdom (UK) Medicines and Healthcare products Regulatory Agency (MHRA) recommends that smoke plume evacuation systems should be used during laser surgery. British operating theatres should have air exchanged at least every 3 minutes through the generation of downward pressure. When possible, the perioperative team should use the highest level of control available. This is operating theatre ventilation together with local exhaust evacuation devices, at or close to the surgical site. Hill et al (2012) discovered that only 66% of plastic surgery units utilised smoke plume evacuators.

Spearman et al (2007) reported that barriers to compliance were surgeons' refusal to use the devices as they were cumbersome - this was also reported by Okoshi et al (2015). A further barrier to implementation was identified by Ball (2010), in that the devices to evacuate plume were noisy and distracting.

Various researchers have reported both complacency and a lack of knowledge as to why they do not use smoke evacuation devices in their practice. Spearman et al (2007), and Ball (2010), found this and Steege et al (2016) in a large study found that 68% of more than 3,800 staff exposed to surgical smoke were not aware of or had no procedures in place to minimise the risk to staff health. More recent evidence shows that the lack of effective procedures to reduce smoke plume in the environment persist putting all staff present at considerable risk (Lee et al 2018).

The suggested solutions include education to raise awareness, introduction of a smoke evacuation program to include all the perioperative team members as well as the use of all existing devices to reduce risk.

By adopting a team centred approach, the perioperative team can discuss at the team brief the required smoke evacuation methods when planning and preparing for a surgical procedure. The team briefing can include the plan for smoke evacuation; the type of equipment and optimal placement of the smoke evacuation device; patient and team member protection methods, including what type of respiratory protection is recommended (AORN 2019).



RECOMMENDATIONS FOR LOCAL POLICY

Environment

As a result of the Health and Safety at Work Act 1974 employers are required to have safe systems of work.

2.7.1 A risk assessment should be undertaken to ensure that the extent of smoke plume in the environment is understood. The Control of Substances Hazardous to Health Regulations (2002) and The Health and Safety at Work Act (1974) detail the responsibilities of the employer and spell out what should be undertaken.

2.7.2 The Control of Substances Hazardous to Health Regulations 2002 requires the employer to manage the risk of exposure to hazardous substances. The employer is also required to take steps to minimise or eliminate risks of exposure to hazardous substances. Where this is not possible, adequate control measures should be in place.

2.7.3 The hierarchy of controls needs to be implemented so that if the hazard of diathermy smoke plume cannot be removed from the environment, it is appropriately managed in a safe manner for patients and staff.

It would be helpful to identify the types of surgery that use a variety of electrosurgical devices, lasers and other smoke plume generating devices, so that the control measures are focused in the correct areas.

2.7.4 The ventilation should be effective in each operating room and always in use when smoke plume is generated.

Staff and patient exposure

The culture of safety within the operating department affects the safe working environment for every member of the surgical team. Given the need to take safety proactively, especially when the evidence for the nature of smoke plume hazards remains low and uncertain, protective measures should be put in place.

2.7.5 The wearing of personal protective equipment is required due to the aerosol nature of the hazard. Collective evidence shows the particles in smoke plume to be respirable.

Electrosurgery (diathermy) generates the smallest aerodynamic size particles (<0.07µm to 0.1µm); laser tissue ablation creates larger particles (~0.31µm), and ultrasonic scalpels create the largest particles (0.35µm to 6.5µm) (AORN 2019).

2.7.6 Research recommends that facemasks are worn as a minimum but their use has also been criticised as insufficient protection. Specific high filtration masks are recommended (Okoshi et al 2015) to be more effective and should be used in addition to smoke evacuation systems.

2.7.7 All surgical team members should have education on diathermy smoke hazards and preventative mechanisms. Multidisciplinary team meetings could have input from manufacturers and then formulate future policy and procedures.

Devices

2.7.8 The selection of suitable devices for use in surgery should be undertaken with assistance from procurement and manufacturers. Trials of suitable products will help to ensure acceptance by users.

2.7.9 Smoke-free champions may help the implementation and use of the appropriate evacuation devices. Education on their use and maintenance should occur.

References and further reading

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