Diathermy smoke: risk to perioperative practitioners?

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The use of diathermy as a cautery device is common practice in perioperative environment, however issues relating to the Health and Safety of the smoke produced through the vaporisation of tissue may still not be recognised by practitioners. This is despite the use of diathermy dating back to the late 19th century (Pollack et al 2000).

Concerns have been expressed about the components of diathermy smoke HSE (2012), which contains 95% water and 5% cellular debris (Ulmer 2008), including a magnitude of different chemicals, some of which may have mutagenic and carcinogenic potential similar to that of cigarette smoke (Ortolano et al 2009).

Brown and Dunn (2013) identified 45 different compounds being present in diathermy smoke. All of these compounds were cross referenced against the COSHH list of approved workplace exposure limits as defined by the HSE (2007) of which 9 were identified as being hazardous to health, four of which are carcinogens, none of the compounds found exceeded the PEL's outlined by the HSE (2007).

Andreasson et al (2009) found that the size of particles found in diathermy smoke was small enough to reach alveoli in the lungs and move into the cardiovascular system, and can cause inflammatory changes in the respiratory tract, nausea, carcinoma, dermatitis and cardiovascular dysfunction. He also discovered that surgical facemasks do not adequately filter particles and as such are not a suitable barrier and advise the use of an extractor. The HSE (2012) found that the quality of air was improved when using an extractor devise.

Pillinger et al (2003) identify two different methods for extracting diathermy plume. The first method involves simply holding a suction device near to the diathermy pencil tip, which is reliant on the experience of the assistant and uses up one of their hands. The preferred method was the use of an integrated diathermy pencil and smoke extraction system, which operates the same as a normal diathermy pencil

and would require little change to operating technique. Spearman et al (2007) found negative attitudes towards such devices amongst surgeons who said that they were too expensive and cumbersome to use.

The regulatory agencies that govern Health and Safety policy such as the OSHA in the United States and COSHH in the United Kingdom are unable produce policy on the evacuation of diathermy smoke until a study is undertaken that can conclusively determine the realistic long and short term health risks.

Al Sahaf et al (2007) advised that staff exposed to surgical smoke should be made aware of the risks. Various nursing organisations provide guidance on the evacuation of diathermy smoke, The International Federation of Perioperative Nurses (IFPN) and the AORN both provide guidelines on the evacuation of diathermy smoke (IFPN 2011), in addition the AORN have devised a smoke evacuation tool kit as guidance for creating hospital policy (AORN 2011). This being the case NICE, who provide national guidance to the NHS when formulating policy, have not as yet provided any guidelines regarding diathermy smoke.

There is no doubt that diathermy smoke contains compounds that are hazardous to health but it is difficult to conclude to what extent individuals are affected by these compounds. However Al Sahaf et al (2007) state that the only ethically acceptable solution would be to inform those who are exposed to diathermy smoke on a daily basis of this potential hazard and to make them aware of the alternatives.

References

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Chemical compound	Chung et al (2010)	Lin et al (2010)	Andreasson et al (2008)	Al Sahaf et al (2007)	Pillinger et al (2003)	Hassan et al (2006)	Weston et al (2009)	Moot et al (2007)
Acetone						✔	✔	
Acetylene								✔
Acrylonitrile	✔						✔	
Ammonia								✔
Benzene						✔	✔	✔
1-3 Butadiene	✔							✔
Butene							✔	
Carbon monoxide							✔	
Cyclohexanone				✔				
Decene				✔				✔
Decane				✔				
Di-t-butylbenzene							✔	
Dodecane				✔				
Ethyl acetate						✔		
Ethyl acetylene	✔							
Ethyl alcohol						✔		
Ethyl benzene				✔		✔	✔	
2-Furancarboxaldehyde								✔
Formaldyhyde							✔	✔
Heptanal				✔				
Heptane						✔	✔	
Hexene							✔	
Hydrogen cyanide								✔
isobutylene	✔							
isooctane							✔	
Isopropyl alcohol						✔		
Methyl ethyl ketone						✔		
Methyl isobutyl ketone						✔		
Nonanal				✔				
1,4-pentadiene	✔							
1-pentene	✔						✔	
Pentadecane				✔				
Perchloroethylene				✔		✔		
Propane nitrile								✔

Propene							✔	
propylbenzene				✔				
propylene	✔							
Styrene						✔	✔	
Tetradecane				✔				
Tetradecene				✔				
Toluene		✔				✔	✔	
Tridecane				✔				
Undecane				✔				
Undecene				✔				
Xylene				✔		✔	✔	

Chemical compound	PEL mg.m3	PEL ppm	Chung et al (2010)	Lin et al (2010)	Al Sahaf et al (2007)	Hassan et al (2006)	Weston et al (2009)	Moot et al (2007)	Surgery type
			mg.m3	mg.m3	mg.m3	mg.m3	mg.m3	ppm	
Acrylonitrile	4.4	2	0.03				ND		TURP
Benzene	3.25	1				0.39	0.012	0.02	abdominal, TUR
1-3 Butadiene	22	10	8.65					0.339	TURP and abdominal
Cyclohexanone	41	10			0.02				abdominal, verruca pilonidal sinus
Ethyl benzene	441	100			0.003	0.1	ND		abdominal, verruca pilonidal sinus
Formaldyhyde	2.5	2					ND	ND	
Hydrogen cyanide	8	5						16.3	abdominal
Toluene	430	100		4.6		ND	0.015		breast, abdominal and TURP
Styrene	191	50				0.61	0.005		abdominal and TURP