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Thank you

Literature search results

Search completed for: Diathermy/electrosurgery (or laser) plume extraction
Search required by: 17th February 2012
Search completed on: 10th February 2012
Search completed by: Alison Price, Librarian, NHS Lincolnshire

Search details
Diathermy/electrosurgery (or laser) plume extraction
Does exposure to plume cause health problems to staff? Does extraction reduce this risk?

Resources searched
EMBASE; HMIC; MEDLINE;

Database search terms: diathermy; DIATHERMY; “laser surgery”; exp LASER THERAPY; laser adj2 surg*; electrosurgery; exp ELECTROSURGERY; plume* adj2 extract*; remov*; extract*; filt*; clear*; “loop electrosurgical excision procedure”; LEEP; electrocautery; ELECTROCOAGULATION; thermocoagulation; “endocavity fulguration”; galvanocautery; cryotherapy; exp CRYOTHERAPY; smoke; plume

Google search string: (diathermy OR electrosurgery OR "laser surgery" OR LEEP OR electrocoagulation OR thermocoagulation OR cryotherapy) (plume OR smoke) ~extraction (risks OR exposure)

Summary
Guidance on the safety of lasers was produced as a Devices Bulletin by the MHRA in August 2008. The relevant extract relating to plume smoke is attached as a pdf. Document.

Guidelines
None found.
Evidence-based reviews

None found.

Published research

1. Electrosurgical smoke: a real concern.

**Author(s):** Chowdhury KK, Meftahuzzaman SM, Rickta D, Chowdhury TK, Chowdhury BB, Ireen ST

**Citation:** Mymensingh Medical Journal: MMJ, July 2011, vol./is. 20/3(507-12), 1022-4742;1022-4742 (2011 Jul)

**Publication Date:** July 2011

**Abstract:** Electrosurgical techniques including laser surgery have expanded greatly in recent years. Pyrolysis of tissue produces smoke. Recently the smoke is being analyzed using Gas Chromatography-Mass Spectrometry. The nature of smoke depends on the rise of temperature of tissue during electro-surgery. The smoke produced at high temperatures contains low concentration of Group-I carcinogens (IARC) such as Benzene, Hydrogen cyanide, Formaldehyde 1,3-Butadiene and Acrylonitrile. Bioaerosol produced at low temperature as in harmonic scissors may contain live multidrug resistant Mycobacterium tuberculosis, viral DNA of HBV, HCV, HIV and HPV. It also contains live malignant cells and dead cellular materials. These produce an unquantified infection risk. The obnoxious smoke causes ocular and upper respiratory tract irritation, creates visual problems for surgeons. Surgical masks are not capable of filtering the produced bioaerosol. Removal of smoke from the site of operation by local exhaust ventilation is not complete. When produced in a closed cavity as in laparoscopic surgery the patient also suffers from carboxyhaemoglobinaemia and methaemoglobinaemia. Methemoglobinaemia is not detected by standard pulse-oximetry. Laser smoke produces congestive interstitial pneumonia, bronchiolitis and emphysema in rats. Chromosomal aberration and sister chromatid exchange have been found in lymphocyte culture of operating room personnel. Occupational safety and health authorities like Occupational Safety and Health Administration (OSHA), National Institute for Occupational safety and Health (NIOSH), American National Standard Institute (ANSI) and Association of Operating room nurses (AORN) are trying to find effective ways for removal of smoke from site of operation and also the real risk to operating room personnel. Answer lies in minimizing the use of electrocautery whenever possible and completes removal of harmful smoke.

**Source:** MEDLINE

2. Is there evidence to support the use of smoke extraction in surgery? A systematic review

**Author(s):** Poona H., Rodriguesb J., Browna H.

**Citation:** European Journal of Surgical Oncology, November 2010, vol./is. 36/11(1125), 0748-7983 (November 2010)

**Publication Date:** November 2010

**Abstract:** Introduction: Diathermy dissection is widely used in breast surgery, but the diathermy plume comprises potentially hazardous substances. Advocates believe using smoke extraction systems may reduce potential health risks to theatre staff. Is there evidence to justify the expense in investing in this technology? Methods: A systematic review was performed. OVID Medline and EMBASE were searched for the descriptor smoke extraction. Abstracts were reviewed to ensure relevance and the included papers obtained and read. Results: Eight articles were identified. Of these, four original articles were relevant to the use of smoke extraction in surgery. Of the four, there was only one
randomised clinical trial between standard diathermy equipment and a diathermy smoke extraction system, in head and neck surgery. The sample size was 15 in each cohort, and the primary endpoint was the amount of smoke reaching operator’s mask, as measured with an aerosol monitor. The smoke extraction system demonstrated a significant reduction in smoke exposure. One article surveyed current attitudes to diathermy smoke and clinical practice. The majority of surgeons surveyed believed the main reason for clearing surgical smoke was to facilitate visualisation of the operative field and the knowledge of potential risks of surgical smoke was limited. Two publications simply provided technical tip of improvising an integrated smoke extraction system. Conclusions: There is limited evidence available justifying smoke extraction diathermy. Do we need more evidence of its efficacy? Does BASO advocate its routine use and the promotion of risk awareness among surgeons?

Source: EMBASE

Full Text:

Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

3. Harmful gases including carcinogens produced during transurethral resection of the prostate and vaporization

Author(s): Chung Y.J., Lee S.K., Han S.H., Zhao C., Kim M.K., Park S.C., Park J.K.

Citation: International Journal of Urology, November 2010, vol./is. 17/11(944-949), 0919-8172;1442-2042 (November 2010)

Publication Date: November 2010

Abstract: Objective: To determine the chemical composition of surgical smoke produced during transurethral resection of the prostate (TURP) and vaporization. Methods: A total of 12 smoke samples were collected from a continuous irrigation suction drainage system to a Tenax absorber at a 0.05 L/min flow rate during TURP and vaporization. The gases were quantitatively and qualitatively analyzed by gas chromatography-mass spectrometry (GC-MS) equipped with a purge and trap sample injector. Results: The main chemical constituents of surgical smoke produced during TURP and vaporization include propylene, allene, isobutylene, 1,3-butadiene, vinyl acetylene, mecaptomethane, ethyl acetylene, diaacetylene, 1-pentene, EtOH, piperylene, propenylacetylene, 1,4-pentadiene, cyclopentadiene, acrylnitrile and butyrolactone. Three of the constituents are very toxic and carcinogenic (1,3-butadiene, vinyl acetylene and acrylonitrile). The amount (mean+/--standard deviation) of chemical components in the 45L of gas and room air mixture produced during TURP and vaporization were as follows: propylene, 0.80+/--0.52mg; isobutylene, 212.85+/--75.65mg; 1,3-butadiene, 0.93+/--0.34mg; ethyl acetylene, 0.09+/--0.05mg; 1-pentene, 6.75+/--1.62mg; 1,4-pentadiene, 0.06+/--0.02mg; and acrylonitrile, 1.62+/--1.19mg. Conclusions: Three of the toxic gases generated during TURP and vaporization are carcinogens (1,3-butadiene, vinyl acetylene and acrylonitrile). Therefore, higher quality filter masks, smoke evacuation devices and/or smoke filters should be developed for the safety of the operating room personnel and patients during TURP and vaporization. 2010 The Japanese Urological Association.

Source: EMBASE

Full Text:

Available in fulltext at EBSCOhost.

Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

4. Surgical smoke management for minimally invasive (micro)endoscopy:
**experimental study.**

**Author(s):** Mattes D, Silajdzic E, Mayer M, Horn M, Scheidbach D, Wackernagel W, Langmann G, Wedrich A

**Citation:** Surgical Endoscopy, October 2010, vol./is. 24/10(2492-501), 0930-2794;1432-2218 (2010 Oct)

**Publication Date:** October 2010

**Abstract:** BACKGROUND: The aim of this study was to investigate the use of surgical smoke-producing procedures such as laser ablation or electrosurgery in minimally invasive microendoscopic procedures. This study proposes a technical solution to efficiently remove surgical smoke from very small endoscopic cavities using microports as small as 20 G (0.9 mm) in diameter.

**METHODS:** The experimental laboratory study used small, rigid, transparent plastic cavity models connected with tubes and pressure sensors to establish an endoscopic in vitro laboratory model. A Kalium-Titanyl-Phosphate (KTP) laser with a 0.5-mm fiber optic probe was used to produce smoke from bovine scleral tissue in the cavity. Endoscopic gas insufflation into the model was generated by pressurized air and a microvalve. A laboratory vacuum pump provided smoke and gas suction via a microvalve. A self-built control and steering system was utilized to control intracavital pressure during experimental insufflation and suction.

**RESULTS:** Problems related to smoke-generating processes, such as laser vaporization or electrocautery, in small closed cavities were first analyzed. A theoretical and mechatronic laboratory model was established and tested. Intracavital pressure and gas flow were measured first without and then with smoke generation. A new construction design for the suction tube was proposed due to rapid obstruction by smoke particles.

**CONCLUSIONS:** Surgical smoke evacuation from endoscopic cavities that are as small as 2 cm in diameter via minimally invasive ports as small as 20 G (0.9 mm) in diameter may be safe and efficient if sufficient gas exchange is provided during smoke generation by laser or electrosurgical instruments. However, maintaining a low and constant pressure in the cavity during gas exchange and adopting a special construction design for the suction tube are essential to provide an excellent view during the surgical maneuver and to minimize potential toxic side effects of the smoke.

**Source:** MEDLINE

**Full Text:**

Available in fulltext at [EBSCOhost](#)

5. **TJC makes it clear: get surgical smoke out of OR.**

**Citation:** Same-Day Surgery, 01 June 2009, vol./is. 33/6(59-60), 01905066

**Publication Date:** 01 June 2009

**Source:** CINAHL

**Full Text:**

Available in fulltext at [EBSCOhost](#)

6. **Joint Commission makes it perfectly clear: get the surgical smoke out of OR... see related article in Hospital Employee Health, June 2008, p. 65.**

**Citation:** Hospital Employee Health, 01 May 2009, vol./is. 28/5(49-51), 07446470

**Publication Date:** 01 May 2009

**Abstract:** Breathing difficulties, 'viable bacteria, and viral particles.'
7. What influences a tertiary surgical team's choice to use smoke extraction devices during electrosurgery?

Author(s): Lockwood B

Citation: ACORN: the Journal of Perioperative Nursing in Australia, 01 September 2008, vol./is. 21/3(38-38), 14487535

Publication Date: 01 September 2008

Source: CINAHL

Full Text:

Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

8. The hazards of surgical smoke.

Author(s): Ulmer BC

Citation: AORN Journal, 01 April 2008, vol./is. 87/4(721-738), 00012092

Publication Date: 01 April 2008

Abstract: Surgical smoke is a part of the environment during operative and invasive procedures. As lasers and electrosurgery have become commonplace, perioperative practitioners are at increased risk for health concerns associated with exposure to surgical smoke. Since the mid 1970s, the body of evidence documenting the hazardous components of surgical smoke has continued to grow. Despite the evidence and recommendations of a variety of organizations, there are no uniform requirements mandating surgical smoke evacuation. This article reviews current research to identify the potential health hazards as well as the current recommendations related to the filtration and evacuation of surgical smoke.

Source: CINAHL

Full Text:

Available in fulltext at EBSCOhost

Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

9. Hazards of surgical diathermy.

Author(s): Makama GJ, Ameh EA

Citation: Nigerian Journal of Medicine: Journal of the National Association of Resident Doctors of Nigeria, October 2007, vol./is. 16/4(295-300), 1115-2613;1115-2613 (2007 Oct-
**Publication Date:** October 2007

**Abstract:** BACKGROUND: Surgical diathermy is an invaluable facility widely used in the operating theatre. Its application in surgical practice is rapidly expanding. However, its use may be accompanied with hazards, which this review is intended to highlight. METHODS: Publications from local and international journals were reviewed. RESULTS: The role of diathermy in surgical practice has expanded beyond imagination in recent years. The patient, surgeon and the theatre staff are frequently exposed to hazards such as burns injury, electrocution, hypoxic stress, inhalation of diathermy plume, and gene mutation. However, strict adherence to preventive measures such as proper connection and handling of diathermy machine, avoidance of inflammable theatre gases, the use of suction device, theatre scavenging system and diathermy plume extraction system could significantly reduce the hazards. CONCLUSION: Continuous exposure to electrocautery appliances in surgical practice is associated with potential risks. Optimizing health and safety in work place should be an ongoing goal. Hence, all methods geared toward the reduction of these risks to health should be emphasized.

**Source:** MEDLINE


**Author(s):** Spearman J, Tsavellas G, Nichols P

**Citation:** Annals of the Royal College of Surgeons of England, March 2007, vol./is. 89/2(162-5), 0035-8843;1478-7083 (2007 Mar)

**Publication Date:** March 2007

**Abstract:** INTRODUCTION: The hazards of surgical smoke are well documented and electrosurgical units (ESUs) are an integral part of surgical practice. The aim of this study was to gauge the opinions of general surgical consultants, specialist registrars and senior theatre nurses in the Wessex Region towards the hazards of ESU smoke. MATERIALS AND METHODS: A literature search was carried out using Ovid Medline. A questionnaire was sent to 169 consultants, SpRs and nurses in the 14 hospitals across the Wessex Region, exploring current practices, perceived hazards and whether adequate precautions were currently in use. RESULTS: Only 3 of 98 surgeons used dedicated smoke extractors, despite the fact the majority (72%) felt that, currently, inadequate precautions were taken to protect staff and patients from surgical smoke. There was also uncertainty about the hazards amongst the respondents. CONCLUSIONS: The use of smoke extraction equipment is very limited. Greater awareness of the hazards and available technology to extract fumes from the theatre environment might lead to greater uptake.

**Source:** MEDLINE

**Full Text:**

Available in fulltext at National Library of Medicine

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Available in print at Lincoln County Hospital Professional Library

11. Current attitudes and practices towards diathermy smoke

**Author(s):** Spearman J., Tsavellas G., Nichols P.

**Citation:** Annals of the Royal College of Surgeons of England, February 2007, vol./is. 89/2(162-165), 0035-8843 (Feb 2007)
**Abstract:** The hazards of surgical smoke are well documented and electrosurgical units (ESUs) are an integral part of surgical practice. The aim of this study was to gauge the opinions of general surgical consultants, specialist registrars and senior theatre nurses in the Wessex Region towards the hazards of ESU smoke. A literature search was carried out using Ovid Medline. A questionnaire was sent to 169 consultants, SpRs and nurses in the 14 hospitals across the Wessex Region, exploring current practices, perceived hazards and whether adequate precautions were currently in use. Only 3 of 98 surgeons used dedicated smoke extractors, despite the fact the majority (72%) felt that, currently, inadequate precautions were taken to protect staff and patients from surgical smoke. There was also uncertainty about the hazards amongst the respondents. The use of smoke extraction equipment is very limited. Greater awareness of the hazards and available technology to extract fumes from the theatre environment might lead to greater uptake.

**Source:** EMBASE

**Full Text:**

Available in fulltext at National Library of Medicine

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Available in print at Lincoln County Hospital Professional Library

12. Surgical smoke and infection control.

**Author(s):** Alp E, Bijl D, Bleichrodt RP, Hansson B, Voss A

**Citation:** Journal of Hospital Infection, 01 January 2006, vol./is. 62/1(1-5), 01956701

**Publication Date:** 01 January 2006

**Abstract:** Gaseous byproducts produced during electrocautery, laser surgery or the use of ultrasonic scalpels are usually referred to as 'surgical smoke'. This smoke, produced with or without a heating process, contains bio-aerosols with viable and non-viable cellular material that subsequently poses a risk of infection (human immunodeficiency virus, hepatitis B virus, human papillomavirus) and causes irritation to the lungs leading to acute and chronic inflammatory changes. Furthermore, cytotoxic, genotoxic and mutagenic effects have been demonstrated. The American Occupational Safety and Health Administration have estimated that 500000 workers are exposed to laser and electrosurgical smoke each year. The use of standard surgical masks alone does not provide adequate protection from surgical smoke. While higher quality filter masks and/or double masking may increase the filtration capability, a smoke evacuation device or filter placed near (2-5 cm) the electrocautery blade or on endoscope valves offers additional (and necessary) safety for operating personnel and patients. Copyright © 2006 The Hospital Infection Society

**Source:** CINAHL

**Full Text:**

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Available in print at Lincoln County Hospital Professional Library

13. Erratum: Diathermy smoke extraction in nasal and oropharyngeal surgery (The Laryngoscope 114:11 (2044))
14. Diathermy smoke extraction in nasal and oropharyngeal surgery.

Author(s): Chisholm EJ, Hobson J, Choa D

Citation: Laryngoscope, November 2004, vol./is. 114/11(2044), 0023-852X;0023-852X (2004 Nov)

Publication Date: November 2004

Source: MEDLINE

Full Text:
Available in fulltext at Ovid
Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.


Author(s): Allen G

Citation: AORN Journal, 01 April 2004, vol./is. 79/4(866-866), 00012092

Publication Date: 01 April 2004

Source: CINAHL

Full Text:
Available in print at a non-ULHT hospital library. Click and complete an online form to request this article/an article from this journal if fulltext is not available.

16. Combined insulation and smoke extraction for the diathermy blade.

Author(s): Chester DL, Titley OG

Citation: Annals of the Royal College of Surgeons of England, March 2004, vol./is. 86/2(130), 0035-8843;0035-8843 (2004 Mar)

Publication Date: March 2004

Source: MEDLINE
17. Randomized clinical trial of suction versus standard clearance of the diathermy plume.

Author(s): Pillinger SH, Delbridge L, Lewis DR

Citation: British Journal of Surgery, September 2003, vol./is. 90/9(1068-71), 0007-1323;0007-1323 (2003 Sep)

Publication Date: September 2003

Abstract: BACKGROUND: Diathermy smoke contains complex hydrocarbons and organic material, and may contain viable tumour cells or viral particles. These particles measure from 0.05 to more than 25 microm, and long-term exposure to such particles may have adverse effects on health. This study investigated whether a suction clearance device reduces the amount of smoke reaching the surgeon's mask.

METHODS: This was a randomized clinical trial in which subjects were randomized to standard diathermy equipment (group 1) or a diathermy smoke extraction system (group 2). All patients underwent thyroid or parathyroid surgery with standard anterior cervical collar incision and division of the strap muscles. The difference in the amount of smoke reaching the level of the operator's mask was measured by means of an aerosol monitor.

RESULTS: Fifteen patients were randomized to each group. The mean amount of smoke detected at the level of the operator's mask was 0.137 mg/m(3) in group 1 and 0.012 mg/m(3) in group 2 (P < 0.001). The maximum amount detected was 2.411 and 0.255 mg/m(3) respectively (P < 0.001). There were no significant differences between the groups in terms of incision time or background particles measured before and after surgery. There was no correlation between gland weight and incision time or amount of smoke detected.

CONCLUSION: Suction clearance of the diathermy plume resulted in a significant reduction in the amount of smoke reaching the level of the operator's mask. Although the risk of diathermy smoke inhalation is currently unknown, use of such a system appears advisable. Copyright 2003 British Journal of Surgery Society Ltd. Published by John Wiley & Sons, Ltd.

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Available in fulltext at the ULHT Library and Knowledge Services’ eJournal collection

Available in print at Lincoln County Hospital Professional Library

Available in fulltext at the ULHT Library and Knowledge Services’ eJournal collection

18. Plume evacuator may lessen health risk for LASIK and PRK.
Author(s): Kronemyer B

Citation: Ocular Surgery News, 15 July 2003, vol./is. 21/14(24-24), 87503085

Publication Date: 15 July 2003

Abstract: A high-filtration mask and high turnover-time ventilation system may also reduce the risk of surgical smoke. Further study is needed.

Source: CINAHL

19. Is it safe to allow smoke in our operating room?

Author(s): Dikes CN

Citation: Today's Surgical Nurse, March 1999, vol./is. 21/2(15-21; quiz 38-9), 1087-1667;1087-1667 (1999 Mar-Apr)

Publication Date: March 1999

Abstract: Researchers have shown that the plume produced during electrosurgery is twice as harmful as laser plume. The smoke produced by ESUs is not routinely evacuated and rises into the air to dissipate haphazardly. Smoke evacuators remove surgical smoke from the operating suite in an efficient and safe manner.

Source: MEDLINE

Full Text:

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20. Carboxyhemoglobinemia due to peritoneal smoke absorption from laser tissue combustion at laparoscopy.

Author(s): Ott DE

Citation: Journal of Clinical Laser Medicine & Surgery, December 1998, vol./is. 16/6(309-15), 1044-5471;1044-5471 (1998 Dec)

Publication Date: December 1998

Abstract: OBJECTIVE: The carbon monoxide (CO) smoke component from tissue pyrolysis was evaluated for peritoneal absorption in patients undergoing laparoscopy to determine its effects and ability to be detected in peripheral blood.SUMMARY BACKGROUND DATA: Previous studies have demonstrated changes in peripheral methemoglobin levels as a result of peritoneal absorption of laser smoke.METHODS: Fifty patients had preoperative, intraoperative, and postoperative levels of carboxyhemoglobin (COHb) and pulse oximetry evaluated. The control group (25) had no laser or cautery used and the study group (25) had carbon dioxide laser used during the laparoscopic procedures.RESULTS: The control group showed no change in COHb, or intra-abdominal CO levels, before, during, and after the procedures, and no change in blood CO or pulse oximetry reading. The laser smoke group showed a statistically significantly elevated (p < .05) peripheral blood COHb levels, a significant increase in intra-abdominal CO concentration, and a lack of correlation of pulse oximetry and blood oxygen saturation experiments.CONCLUSIONS: CO is created in extremely large quantities during laser use at laparoscopy and is absorbed through the peritoneal cavity. Symptoms of smoke poisoning can be seen with these elevations. Continuous or intermittent removal of smoke produced from laser use is recommended.

Author(s): Brandon HJ, Young VL

Citation: Surgical Services Management, 01 March 1997, vol./is. 3/3(14-16), 10798269

Publication Date: 01 March 1997

22. Smoke evacs extract airborne bacteria from O.R. laser sites.

Author(s): Fitzgerald J, Diekman JM

Citation: Hospital Materials Management, September 1992, vol./is. 17/9(2, 22), 0888-3068;0888-3068 (1992 Sep)

Publication Date: September 1992

23. Laser smoke effect on the bronchial system.

Author(s): Freitag L, Chapman GA, Sielczak M, Ahmed A, Russin D

Citation: Lasers in Surgery & Medicine, 1987, vol./is. 7/3(283-8), 0196-8092;0196-8092 (1987)

Publication Date: 1987

Abstract: The photoablation of endobronchial tumors produces smoke which is partly inhaled by the patient as well as the surgical staff. In an animal study we investigated whether a single exposure or repetitive exposures to smoke might have harmful side effects on the airways. Eleven sheep were exposed to smoke produced by laser-vaporizing (6,500 J) sections of bronchial tissue (1 cm3) in a Plexiglas chamber. The smoke analysis revealed 0.92 mg/liter particles with a mean particle size of 0.54 micron. Carbon monoxide content was estimated as 0.04%. We measured the effects of one or three separate ten-minute exposures on airway resistance, gas exchange, and mucociliary clearance rate in the trachea. We found that the smoke inhalation resulted in a decrease of arterial PO2 with relatively little change in airway mechanics. Tracheal mucus velocity, a marker of lung mucociliary clearance, was significantly depressed in a dose-dependent manner with increasing smoke exposures. Results of bronchoalveolar lavages performed before and one day after the exposure showed that the smoke inhalation induced a severe inflammation with dramatic increases of inflammatory cells. The total number of cells per milliliter lavage return increased from 3.2 million to 25 million; percent neutrophils increased from 2.3 to 45.6% and percent macrophages decreased from 86 to 41%. These findings indicate that the side effects of smoke inhalation during intrabronchial laser surgery should not be neglected. The impairment of the defense mechanism of the lung
combined with the inflammation as well as hypoxia might be fatal in compromised patients. Effective smoke removal devices should be developed to protect the patient as well as the surgeon.

**Source:** MEDLINE

**Full Text:**

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**Some additional results**

24. **Title:** Surgical smoke and the dermatologist.

**Citation:** Journal of the American Academy of Dermatology, September 2011, vol./is. 65/3(636-41), 0190-9622;1097-6787 (2011 Sep)

**Author(s):** Lewin JM, Brauer JA, Ostad A

**Abstract:** BACKGROUND: The use of electrosurgery and lasers by dermatologists and dermatologic surgeons has increased in recent years with the growth of technology and procedures performed. These devices produce surgical smoke that has been demonstrated to harbor live viruses and bacteria in addition to hazardous chemicals. OBJECTIVE: We sought to review the literature on surgical smoke, its effects on those exposed, and measures that may be used to protect dermatologists and their staff. METHODS: We conducted a review of the literature on surgical smoke during the last 25 years. RESULTS: The studies reviewed indicate the potential for infection, carcinogenesis, and pulmonary damage as a result of exposure to surgical plume. LIMITATIONS: There is no inclusion of literature and subsequent findings published greater than 25 years prior. CONCLUSIONS: It is evident from our review that surgical smoke poses potential health risks to dermatologists who perform procedures using electrocautery and lasers. We recommend diligent use of high-filtration masks in addition to smoke evacuation systems to dermatologists performing laser surgery and using electrocautery. Furthermore, we advocate investigation into quantifying the exposure of dermatologists to surgical smoke in the outpatient setting. Copyright Copyright 2010 American Academy of Dermatology, Inc. Published by Mosby, Inc. All rights reserved.

**Publication Type:** Journal Article, Review

**Source:** MEDLINE

25. **Title:** Laser-generated air contaminants from medical laser applications: a state-of-the-science review of exposure characterization, health effects, and control.

**Citation:** Journal of Occupational & Environmental Hygiene, July 2011, vol./is. 8/7(447-66), 1545-9624;1545-9632 (2011 Jul)

**Author(s):** Pierce JS, Lacey SE, Lippert JF, Lopez R, Franke JE

**Abstract:** The clinical use of lasers in surgery began in 1973 with applications of the carbon dioxide laser in otolaryngology, and since then the use of lasers has become commonplace in many medical and surgical specialties. Nonetheless, when biological tissue is subjected to laser radiation, the target cells can be vaporized, resulting in the aerosolization of their contents and the subsequent exposure of health care workers to laser-generated air contaminants (LGACs). The purpose of our analysis was to summarize and present all of the published literature pertaining to the laser-induced plume chemical and physical composition, health effects, and methods of control. The objective was to identify knowledge gaps within exposure science to set a research agenda for the
protection of health care personnel exposed to LGACs. A literature search was performed using the PubMed database using a variety of search strategies and keyword combinations. To locate additional studies, we systematically searched the reference lists of all studies identified by our search, as well as key review papers. To date, researchers have identified roughly 150 chemical constituents of plume, as well as fine and ultrafine particulate matter, which has been shown to include viable cellular material, viruses, and bacteria. However, very few studies have attempted to characterize the effects of laser system type, power, and tissue treated, as it relates to LGAC exposure. Furthermore, current control strategies do not appear to be adequate in preventing occupational exposure to LGACs.

**Publication Type:** Journal Article, Review

**Source:** MEDLINE

**Full Text:** Available in *fulltext* at Ingenta

26. **Title:** Clearing the air in surgery: Hazards, risks, solutions and standards

**Citation:** Lasers in Medical Science, November 2010, vol./is. 25/(S47), 0268-8921

**Author(s):** Smalley P.J.

**Abstract:** Surgical plume has been a controversial issue throughout this decade, and while there are still some areas lacking consensus, overwhelming evidence points to the fact that surgical plume contains vaporised and aerosolised tissue, and therefore biohazards, including carbon, toxic gases, viral particulates, bacteria, DNA, blood, and blood borne pathogens. This occurs whenever energy sources (lasers, diathermy, ultrasonics, etc.) are used to produce thermal injury to tissues by heating individual cells to the point of disruption. When cells disrupt, they release intracellular contents, which are equivilant to other contaminated body substances, requiring handling according to blood borne pathogen standards. Around the world, documents including standards, professional guidelines, recommended practices, and regulations, are starting to recognise that the presence of surgical plume is a workplace hazard, and the daily exposure to it, is an occupational risk for perioperative personnel. Furthermore, accumulated plume during laparoscopic surgery, is a patient safety hazard, resulting from a decrease in oxygenation of tissues. Because of these facts, appropriate engineering controls (plume evacuation systems) and procedural controls (work practices) should be mandated, regardless of clinical practice setting, or procedure being performed. Education is the key to developing an increase in awareness of the hazard and it's risks, as well as the clear and simple solution-a plume evacuation system for every plume producing procedure, good work practices, and compliance with standard precautions for all contact with airborne contaminants resulting from surgical plume.

**Publication Type:** Journal: Conference Abstract

**Source:** EMBASE

**Full Text:**

Available in *fulltext* at Ingenta

27. **Title:** Randomized clinical trial of suction versus standard clearance of the diathermy plume

**Citation:** British Journal of Surgery, September 2003, vol./is. 90/9(1068-1071), 0007-1323 (01 Sep 2003)
Author(s): Pillinger S.H., Delbridge L., Lewis D.R.

Abstract: Background: Diathermy smoke contains complex hydrocarbons and organic material, and may contain viable tumour cells or viral particles. These particles measure from 0.05 to more than 25 mum, and long-term exposure to such particles may have adverse effects on health. This study investigated whether a suction clearance device reduces the amount of smoke reaching the surgeon's mask. Methods: This was a randomized clinical trial in which subjects were randomized to standard diathermy equipment (group 1) or a diathermy smoke extraction system (group 2). All patients underwent thyroid or parathyroid surgery with standard anterior cervical collar incision and division of the strap muscles. The difference in the amount of smoke reaching the level of the operator's mask was measured by means of an aerosol monitor. Results: Fifteen patients were randomized to each group. The mean amount of smoke detected at the level of the operator's mask was 0.137 mg/m<sup>3</sup> in group 1 and 0.012 mg/m<sup>3</sup> in group 2 (P < 0.001). The maximum amount detected was 2.411 and 0.255 mg/m<sup>3</sup> respectively (P < 0.001). There were no significant differences between the groups in terms of incision time or background particles measured before and after surgery. There was no correlation between gland weight and incision time or amount of smoke detected. Conclusion: Suction clearance of the diathermy plume resulted in a significant reduction in the amount of smoke reaching the level of the operator's mask. Although the risk of diathermy smoke inhalation is currently unknown, use of such a system appears advisable.

Publication Type: Journal: Article

Source: EMBASE

Full Text: Available in fulltext at Ingenta

28. Title: Operating room nursing and lung cancer risk in a cohort of female registered nurses.

Citation: Scandinavian Journal of Work, Environment & Health, April 2007, vol./is. 33/2(140-7), 0355-3140;0355-3140 (2007 Apr)

Author(s): Gates MA, Feskanich D, Speizer FE, Hankinson SE

Abstract: OBJECTIVES: Smoke generated during laser surgery and electrocautery contains respiratory irritants and human carcinogens. Although laboratory and animal studies have demonstrated that this smoke has inflammatory and mutagenic potential, no population-based studies of the health effects of exposure to surgical smoke have been published. We examined the association between duration of employment as an operating room nurse, a proxy measure for surgical smoke exposure, and subsequent lung cancer risk. METHODS: This study was conducted among 86 747 women in the Nurses' Health Study. Information on the duration of prior operating room employment was collected in 1984, and the women were followed for incident, confirmed lung cancer. Cox proportional hazards regression was used to model the incidence rate ratio of lung cancer for each exposure category using women with no prior operating room employment for comparison. All of the models were adjusted for age, smoking history, passive smoke exposure, fruit and vegetable consumption, and alpha carotene and lycopene intake. RESULTS: A history of operating room employment was not associated with an increased rate of lung cancer in multivariable analyses [rate ratio (RR) 0.99, 95% confidence interval (95% CI) 0.86-1.15]. In fact, nurses in the highest exposure category, > or =15 years of operating room employment, had a significantly lower rate of lung cancer than nurses with no prior operating room employment (RR 0.58, 95% CI 0.37-0.91), possibly due to confounding by overall health status or residual confounding by smoking history. CONCLUSIONS: Long-term exposure to surgical smoke, as measured by the duration of operating room employment, does not appear to increase the risk of lung cancer.
29. **Title:** Risks associated with exposure to surgical smoke plume: a review of the literature.

**Citation:** AORN Journal, December 2007, vol./is. 86/6(1013-20; quiz 1021-4), 0001-2092;0001-2092 (2007 Dec)

**Author(s):** Bigony L

**Abstract:** Electrosurgery, laser ablation, and ultrasonic scalpel dissection create a gaseous by-product commonly referred to as surgical smoke or plume. Smoke evacuation devices have been shown to be effective in limiting exposure to the noxious odor and potential health hazards of smoke and plume; however, these devices have not been used routinely and consistently in many ORs. This article reviews five quantitative research studies that explore the characteristics of smoke plume produced during surgery and presents the evidence of the need for consistent use of smoke evacuation systems. AORN, Inc, 2007

**Publication Type:** Journal Article, Review

**Source:** MEDLINE

**Full Text:**
Available in fulltext at EBSCOhost

30. **Title:** The hazards of diathermy plume. Part 2. Producing quantified data

**Citation:** British journal of perioperative nursing : the journal of the National Association of Theatre Nurses, October 2004, vol./is. 14/10(452, 454-456), 1467-1026 (Oct 2004)

**Author(s):** Scott E., Beswick A., Wakefield K.

**Abstract:** Laser and electrocautery devices used during surgery produce smoky emissions that may contain vapours and particulate aerosols, which can have a chemical and biological impact on those exposed. A group of theatre staff and specialist nurses at Rotherham District General Hospital got together to draw up a risk assessment into the possible occupational exposure of theatre staff, with a view to eliminating or controlling these hazards as far as possible.

**Publication Type:** Journal: Article

**Source:** EMBASE

**Full Text:**
Available in fulltext at EBSCOhost

31. **Title:** The hazards of diathermy plume. Part 1. The literature search.

**Citation:** British Journal of Perioperative Nursing, September 2004, vol./is. 14/9(409-14),
Author(s): Scott E, Beswick A, Wakefield K

Abstract: Laser and electrocautery devices used during surgery produce smoky emissions that may contain vapours and particulate aerosols, which can have a chemical and biological impact on those exposed. A group of theatre staff and specialist nurses at Rotherham District General Hospital got together to draw up a risk assessment into the possible occupational exposure of theatre staff, with a view to eliminating or controlling these hazards as far as possible.

Publication Type: Journal Article, Review

Source: MEDLINE

Full Text: Available in fulltext at EBSCOhost

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A smoky plume produced by procedures involving lasers or electrosurgery can contain matter that is harmful and deleterious if inhaled.

Extract: Smoke inhalation
Members of staff and patients or clients may suffer from inhalation effects of smoke and vapour (plume) following tissue destruction. The debris contained in the plume may produce airway irritation and nausea. There is some evidence that inhaled cellular and viral debris dispersed in the air have resulted in certain adverse effects [1]. Measures for dealing with the effects of smoke plume are discussed in section 5.13. This section is attached as a pdf. document http://www.mhra.gov.uk/Publications/Safetyguidance/DeviceBulletins/CON014775

This poster provides guidance on minimising the smoke plume. http://www.mhra.gov.uk/Publications/Postersandleaflets/CON041330

Chemical composition of smoke produced by high-frequency electrosurgery in a closed gaseous environment
C Hensman, D Baty, RG Willis… - Surgical endoscopy, 1998 - Springer
... Key words: High-frequency electrocoagulation — Electro- surgical smoke ... Concerns about the electrical hazards [1] of HF electrosurgery have overshadowed the risks associated with the generation of smoke from high-temperature pyrolysis of ... Apparatus and smoke production ...
Cited by 45 - Related articles - Lancashire Teaching Hospitals - Find@The Christie - BL Direct - All 5 versions

Smoke in the operating theater: an unregarded source of danger
The Christie Online Journals
R Hollmann, CE Hort, E Kammer… - Plastic and …, 2004 - journals.lww.com
Cited by 16 - Related articles - Lancashire Teaching Hospitals - BL Direct - All 5 versions

Surgical smoke: a review of the literature
WL Barrett… - Surgical endoscopy, 2003 - Springer
... WK, Nezhat F, Nezhat C, Forrest D, Reeves WG (1987) Smoke from laser surgery: is there ... 1990) Studies on the transmission of viral disease via the CO2 laser plume and ejecta. ... Cuschieri A (1998) Chemical composition of smoke produced by high-frequency...
electrosurgery in a ...
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Viral disease transmitted by laser-generated plume (aerosol)
JM Garden, MK O’Banion, AD Bakus... - Archives of ..., 2002 - Am Med Assoc
... with the proved potential for disease transmission, that safety precautions during laser surgery be strictly ... in the vapor of warts treated with carbon dioxide laser or electrocoagulation: detection and ... Human papillomavirus DNA in CO 2 laser—generated plume of smoke and its ...
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The hazards of surgical smoke. Not to be sniffed at!
... It focuses on the risks to perioperative team members arising from the production of smoke during electrosurgical ... MeSH Terms. Air Pollution, Indoor/analysis; Electrosurgery/instrumentation*; Environmental Monitoring; Equipment Safety; Great Britain; Humans; Infection/etiology; ...
Cited by 11 - Related articles - Lancashire Teaching Hospitals - Find@The Christie - BL Direct

Surgical smoke without fire: the risks to the plastic surgeon
The Christie Online Journals
ROS Karoo, IS Whitaker, G Offer... - Plastic and ..., 2004 - journals.lww.com
... The risks of smoke plume exposure generated by these electrosurgery devices have been investigated ... 19 We hope that more surgeons who routinely encounter the surgical smoke plume will adopt ... F., Nezhat C., Forrest, D., and Reeves, WG Smoke from laser surgery: Is there a ...
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Results of a survey on current surgical smoke control practices
BE Edwards... - AORN, 2008 - Elsevier
... Table 5. Frequency of No Smoke Exhaust by Procedure, Percent responding. Procedure type, always or often, never or seldom. Electrosurgery/electrocautery/ diathermy. • Condyloma or dysplasia treatment. 33%, 57%. ... 28%, 60%. • Standard (no-laser) surgery. 39%, 46%. ...
Cited by 12 - Related articles - Lancashire Teaching Hospitals - Find@The Christie - BL Direct - All 10 versions

Cytotoxicity of electro-surgical smoke produced in an anoxic environment
C Hensman, EL Newman, SM Shimi... - The American journal of ..., 1998 - Elsevier
... High-frequency electro-surgery is one of the ancillary technologies used in these endoscopic interventions ... of the important toxic components and in the design of techniques to minimize their production. ... Undiluted smoke medium was clearly cytotoxic to MCF-7 cells after only 15 ...
Cited by 11 - Related articles - Lancashire Teaching Hospitals - Find@The Christie - BL Direct - All 7 versions

Laser safety
DH Sliney - Lasers in surgery and medicine, 1995 - Wiley Online Library
... tissue (“smoke”) from laser surgery has often been referred to as “laser smoke” or the “laser plume,” suggesting that it is unique to laser surgery. ... led to the result that vaporized tissue fragments from bone saws and pyrolysis products of tissue from electrosurgery have been ...
Cited by 55 - Related articles - Lancashire Teaching Hospitals - Find@The Christie - Library Search - BL Direct - All 5 versions

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SR Youker... - Facial plastic surgery, 2001 - thieme-connect.com
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Complications and recommended practices for **electrosurgery** in laparoscopy

MP Wu, CS Ou, SL Chen, EYT Yen... - The American journal of ..., 2000 - Elsevier

... current at 17.6 W and 625 kHz frequency are used to perform **electrocoagulation** for 5... to large amounts of blood or fluid, surgeons should consider replacing gloves before reactivating **electrosurgery**. ... they understand how it is to be handled and the inherent **risks** associated with ...

Human papillomavirus DNA in **LEEP plume**

AK Sood, Z Bahrani-Mostafavi... - Infect Dis Obstet ..., 1994 - downloads.hindawi.com

... **Electrosurgery** may cause less tissue destruction than laser and may liberate more intact cells, including viral DNA, which ... 1. Cartier R, Sopena B, Cartier I: Use of the **diathermy** loop in the diagnosis and treatment ... Mihashi S, Jako GJ, Incze J, et al.: **Laser surgery** in otolaryngology ...

Controlling surgical **smoke**: A team approach

K Ball - Information Booklet, 2004 - icmedical.com

... activates the **smoke** evacuator can be connected to the laser or **electrosurgery** unit system. ... 4th Congress of the International Society for **Laser Surgery**, Tokyo, Japan Society for Laser ... in the vapor of warts treated with carbon dioxide laser or **electrocoagulation**: detection and ...

Analysis of surgical **smoke** produced by various energy-based instruments and effect on laparoscopic visibility


... on the trans- mission of viral disease via the CO2 laser **plume** and ejecta. ... Chemical composition of **smoke** produced by high-frequency **electrosurgery** in a closed gaseous environment. ... in the vapor of warts treated with carbon dioxide laser or **electrocoagulation**: Detection and ...

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R Weston, RN Stephenson, PW Kutarski... - Urology, 2009 - Elsevier

... and PF Wilson et al., Composition of volatile organic compounds in **diathermy plume** as detected ... Willis et al., Chemical composition of **smoke** produced by high-frequency **electrosurgery** in a ... D. Ott, **Smoke production** and **smoke** reduction in endoscopic surgery, Endosc Surg 1 ...

Contamination **risks** associated with **electrosurgery**

JE Sebben - Archives of dermatology, 1990 - Am Med Assoc

... and might, therefore, erroneously conclude that it is bet¬er to use a technique producing **electrocoagulation**: ... to patients and medical personnel.2830 **Smoke** evacuation systems may have as importanta place in **electrosurgery** as theydo in **laser surgery.**2731 Until ...
A comparative analysis of adhesion reduction, tissue effects, and incising characteristics of electrosurgery, CO2 laser, and Nd:YAG laser at operative laparoscopy: an ... 
AA LUCIANO, GN FRISHMAN... - Journal of ..., 1992 - liebertonline.com

... problem of smoke production has been minimized by better insufflators, which replace the laser plume with smoke ... In Proceeding of the 4th Congress of International Society for Laser Surgery ... Soderstrom RM: Preventing adhesions- electrosurgery: advantages and disadvantages ...

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Floating aerial blood mists in the operating room
K Ishihama, S Sumioka, K Sakurada... - Journal of hazardous ..., 2010 - Elsevier
... Laser and electrosurgery create surgical smoke or plume, which has potential health ... this involved human papilloma virus and occurred during gynecological laser surgery [6]. Identification ... laser plume raises concern regarding potential risks from exposure to the surgical plume. ...

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JKM Fan, FSY Chan... - Asian Journal of Surgery, 2009 - Elsevier
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Surgical Smoke: What Do We Know
D Watson - 2011 - enfermerasapollonyesterilizacion.cl
... When using the larger tubing for evacuation, you can place it farther away from the electrosurgery pencil site ... The translated guidelines state: "Comparisons between laser smoke and diathermy smoke (electrocoagulation) show that even diathermy smoke can contain ...

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