Surgical procedures that use an electrosurgical unit or laser to cauterize tissue will generate surgical smoke and aerosol that pose inherent risks to all the parties involved. This paper shall address these risks by including discussion on generation and composition of the plume, potential adverse effects, and the present state of acceptance and use of evacuation systems. OSHA and NIOSH regulations, warnings and bulletins are listed as is a comprehensive bibliography. Finally you will be introduced to the design by D3, LLC, which is interchangeable with several evacuation systems now on the market.

Over the last 10 years there has been an increased amount of concern regarding the smoke generated during surgical procedures when using electrosurgery units or lasers. Operating Room personnel are exposed to toxic chemicals every time they participate in a surgical procedure in which an electrosurgical unit or a laser comes into contact with tissue. The thermal destruction of tissue that occurs with the use of these devices creates hazardous smoke byproducts. The effects on health care personnel include upper respiratory tract irritation, irritation to the eyes, unpleasant odors, and possibly cellular mutagenic potential. The number of toxic chemicals contained within this surgical smoke is vast. They include carbon monoxide, hydrogen cyanide, methane, formaldehyde, benzene, phenol, toluene, and styrene, as well as many others. In addition, research studies have confirmed that the smoke can also contain live and dead cellular material (including blood fragments), bio-aerosols, and live viruses.

During the early days of cautery and cloth masks, surgeons and OR staff knew that cautery procedures created offensive smoke and foul smelling odors, and occasionally obstructed the surgeons visual field. But these health care professionals did not question the consequences of this smoke on their own health nor the patient’s health. Likewise, no one thought about the inherent harm from splatter in the early days of power dental drills. The smoke was not considered hazardous, and the odor was simply the consequence to use the latest surgical tool technology.

In the 1960s, thermal lasers were introduced and the contents of the generated plume finally began to be questioned. The reason people were concerned with the thermal laser plume was likely due to the intensity of the plume produced. Thermal lasers vaporize tissue very rapidly, and the cells virtually burst and turn into vapor. The result of this explosive tissue response is the generation of thick plumes of smoke and offensive odors. By comparison, electrosurgical energy causes dissection and hemostatis more slowly, and the tissue response is not as explosive.

In the early 1980s, the perioperative nursing community began to examine the effects of the smoke created by cautery procedures. Researchers and laser clinicians also became concerned about the dangers associated with breathing the smoke generated during electrosurgery and laser surgery. Since then, the results of these studies have shown that electrosurgery smoke may be even more hazardous than the smoke created by lasers, due to the lower temperatures involved in electrosurgery.

Research during this time revealed the following:

- The plume particles ranged in size from 0.1 to 0.8 microns. Standard surgical masks are unable to effectively filter out such small particles.
- Rats exposed to laser plume exhibited pathological changes to their lungs.
• Intact DNA from human papilloma virus (HPV) vaporized by a CO2 laser could be discharged into the air.

Research in the 1990s has revealed:
• The presence of HIV DNA in laser smoke was found in culture on the 14th day and non-viable by the 28th day.

Numerous articles have been published that document the contents of the electrocautery/laser plume and address the transmission of hazardous chemical contaminants, bacteria, viruses and viable cells in this plume. As more health care workers were educated on these dangers, smoke evacuation, plume management or site specific air purification in the operating room environment became an emerging concern. Hospitals began to purchase smoke evacuators to remove the smoke generated during electrocautery and laser surgery.

There are reports of health care workers who have been infected with HIV caused by exposure to blood and other body fluids, and through injuries with sharp objects. This leads to the concern of the potential transmission of HIV or other blood borne pathogens from the aerosols produced by electrosurgery instruments.

In 1996, the Association of Operating Room Nurses (AORN) held the first surgical smoke conference at AORN Headquarters. The same year, the National Institution for Occupational Safety and Health (NIOSH) issued a hazard control statement that calls for evacuation of laser and electrosurgical unit (ESU) generated smoke.

Surgical smoke plume (smoke, aerosols, and particulate matter) is created by the thermal or mechanical destruction of tissue or bone. Thermal surgical instruments impart thermal energy to tissue and include electrosurgical devices and surgical lasers, while the mechanical surgical instruments impart mechanical energy and include bone augers and saws, reamers and drills. 1

Thermal instruments transmit heat energy to the cell membrane, the heat vaporizes the intracellular fluid, and in turn the pressure inside the cell increases until the cell membrane bursts. Although electrosurgical devices and lasers may cause varying degrees of explosive responses in tissue cells, both have the capability to heat tissue to 100°C. Concurrently, the intense heat created by the ESU chars the protein and other organic matter inside the cell, causing thermal necrosis in adjacent cells. This charring of the cells simultaneously releases other hazardous contaminants, including carbonized cell fragments and gaseous hydrocarbons (hundreds which are still not identifiability). These cellular explosions create a plume of smoke containing mostly water vapor that is released into the atmosphere of the operating room, most likely being inhaled by everyone within the surgical suite. Research findings suggest that there is negligible difference between electrosurgery generated smoke and laser generated smoke. Electrosurgical smoke and aerosol can be just as hazardous and noxious as laser smoke and aerosol. 2

The potential hazards of inhaling these aerosols and smoke have been documented by many medical journals. If they are not properly evacuated, these small airborne particles can easily penetrate deep within the respiratory tract. 3
Exactly what kinds of particles comprise the makeup of surgical smoke and aerosol? The potential hazards vary, and essentially depend upon which energy source is being used to create the smoke and the tissue that is being cauterized or aerosolized. In general, the composition of surgical smoke and aerosol is composed of roughly 95% water vapor and 5% organic mutagenic compounds and other matter. The hazard posed to exposed health care personnel are both biological (aerosolized blood, carbonized tissue, fragmented or intact infectious bacteria and viruses) and chemical (carcinogens, mutagens, allergens, irritants to the respiratory tract and other toxins such as benzene, toluene and formaldehyde). 4

The range of the particle size in surgical smoke and aerosol is 0.10 to 0.80 microns (µm), with a mass median aerodynamic diameter of 0.31 µm. This is the most significant particle size due to its optimal size for deposition into the lower respiratory tract. Several significant pathogens fall within this range to include Human Immunodeficiency Virus (0.180 µm), Hepatitis B virus (0.042 µm), Human Papilloma Virus (0.045 µm), and mycobacterium tuberculosis (0.500 µm). The table below shows the typical virus and particle sizes.

<table>
<thead>
<tr>
<th>Particle Type</th>
<th>Size Range (microns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viruses</td>
<td>0.01 - 0.3</td>
</tr>
<tr>
<td>HIV</td>
<td>0.18</td>
</tr>
<tr>
<td>HPV</td>
<td>0.045</td>
</tr>
<tr>
<td>Surgical Smoke</td>
<td>0.1 - 3.0</td>
</tr>
<tr>
<td>Bacteria</td>
<td>0.3 - 15.0</td>
</tr>
<tr>
<td>Lung damaging Dust</td>
<td>0.5 - 5.0</td>
</tr>
</tbody>
</table>

Though an exact determination as to the number of particles present in the surgical plume is dependent on several surgical variables to include type of tissue dissected or cauterized, duration of the surgery, etc. it generally ranges from 1,000,000 to 1,000,000,000 particles.

Researchers have identified a wide variety of toxic chemical byproducts in surgical smoke and aerosol. More than eighty organic compounds are produced from the pyrolysis of proteins and lipids, some of which are listed in the table below.

<table>
<thead>
<tr>
<th>Table 2. Toxic Chemical Byproducts of Tissue Pyrolysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>acrolein acetonitrile acrylonitride acetylene</td>
</tr>
<tr>
<td>alkyl benzenes benzene butadiene butene</td>
</tr>
<tr>
<td>carbon monoxide cresols ethane ethene</td>
</tr>
<tr>
<td>ethylene formaldehyde free radicals hydrogen cyanide</td>
</tr>
<tr>
<td>isobutene methane phenol polycyclic aromatic hydrocarbons (PAH)</td>
</tr>
<tr>
<td>propene propylene pyridene pyrrole</td>
</tr>
<tr>
<td>styrene toluene xylene</td>
</tr>
</tbody>
</table>

It has been ascertained that surgical smoke and aerosol contain potential chemical and biological hazards, impair the field of view afforded to the operative team, and have an offensive odor. But what is the actual harm produced by these “potential” hazards? Are
there sufficient quantities of chemical and biological constituents of surgical smoke and aerosol to cause infection or other detrimental effects on operating room personnel or patients?

An estimated 500,000 health care workers are exposed to measurable amounts of this electrosurgical or laser-generated mutagenic plume every year. The extent of that exposure varies among the staff present in the OR. Anesthesiologists, circulating nurses and surgical technicians are exposed multiple times per day whereas a surgeon's exposure may be on the average of two times per week. Even though the surgeon would receive a higher concentration of the plume than the circulating nurse due to his proximity, the individuals that receive multiple daily exposure are the ones that face the highest long term chronic risks. Even those individuals that are not standing near the surgical field, such as observers in the OR, are exposed to the toxic effects of the mutagenic plume.

The compounds contained in the surgical smoke do have documented harmful health effects, as described in the examples below:

Acrolein, CH\textsubscript{2}CHO, is highly toxic if inhaled or ingested. It has an acrid odor and its vapors irritate the nose and throat and can severely aggravate the eyes, resulting in reddening of the eyelids, swelling and tearing. Severe exposure, while unlikely, could result in shortness of breath, nausea, vomiting, pulmonary edema, diarrhea, prostration and loss of consciousness.

Benzene, C\textsubscript{6}H\textsubscript{6}, is a liquid aromatic hydrocarbon used in or to manufacture a wide variety of chemical products, including DDT, detergents, insecticides, and motor fuels. Prolonged low-level exposure increases the risk of leukemia. Prolonged skin contact or exorbitant inhalation may cause irritation to the eyes, nose, and respiratory tract; headaches; nausea; drowsiness; dizziness; euphoria; or intoxication.

Formaldehyde, HCHO, the simplest aldehyde, used for manufacturing phenolic and melamine resins, dyes, fertilizers, and embalming fluids and in aqueous solution as a disinfectant and preservative. It is very toxic, carcinogenic, and corrosive to skin and mucous membranes. Vapors and gas are irritating at very low levels. It is one of the most prevalent causes of occupational skin disease. Repeated or excessive exposure may cause kidney damage.

Hydrogen Cyanide, HCN, is an extremely poisonous and flammable liquid that is a common ingredient in rat poison. If inhaled in large quantities, it causes tachypnea (rapid breathing), resulting in increased cyanide intake, followed by convulsions, dyspnea, paralysis, and respiratory arrest. Death may occur within minutes. Smaller concentrations can cause headache, nausea, vertigo, and vomiting. HCN levels of 100 PPM have been measured at lasing sites, which is 10 times higher than approved limits.

Toluene, CH\textsubscript{3}C\textsubscript{6}H\textsubscript{5}, is used as an industrial solvent and is irritating to the nose, eyes, and respiratory tract. A narcotic effect can be produced if inhaled in high concentrations, which may lead to a coma as well as kidney and liver damage. Chronic poisoning has resulted in leukopenia, anemia, and bone marrow hyperplasia. Chronic inhalation during pregnancy has been linked with teratogenic effects on the fetus.

Operating Room personnel may experience headaches, nausea, conjunctivitis, myalgia, or rhinitis after breathing surgical smoke. Respiratory illnesses can result in high rates of
employee absences in the OR departments. The impact of the surgical smoke has been well documented, and the most common adverse clinical effects are listed below.

**Decreased Vision**
Surgical smoke and aerosol impairs not only the vision of the surgeon, but the rest of the OR staff in both open and minimally invasive surgical procedures. This lack of visibility can result in lengthening the procedure, adding to expensive OR time and subjecting the patient to prolonged time under anesthesia.

**Noxious Odors**
Aesthetically, surgical smoke and aerosol has an odor that is extremely unpleasant to surgeons, nurses, patients, and any other person in the operating room. The odor clings to hair, exposed skin surfaces, and surgical attire. It can irritate the eyes and cause nausea and vomiting. Evidence shows that the offensive smell heightens patient anxiety. If one can smell the surgical smoke, one should be very concerned for your health, as you are inhaling harmful gases, such as benzene, hydrogen cyanide, formaldehyde, phenol, and toluene.

**Lung Disease**
Breathing in surgical smoke can cause severe lung problems, including bronchiolitis, congestive interstitial, pneumonia, and emphysema.

**HIV Infection**
There is an increasing concern about the transmission of infectious diseases from patients to health care workers and documented proof that cell cultures have become infected by the smoke or aerosol produced when electrosurgical devices or lasers were used on cell cultures infected with HIV, but as of yet there are no documented cases of human infection by the way of HIV infected aerosols.

Advisory and regulatory bodies all agree on the need for the removal of surgical smoke and aerosol. The professional, standard-setting and regulatory organizations listed below all agree on safety precautions to minimize, if not eliminate, the potential harm from the absorption or inhalation of surgical smoke. These organizations include:

- American Conference of Government and Industrial Hygienists (ACGIH)
- American National Standards Institute (ANSI)
- American Society for Laser Medicine and Surgery (ASLMS)
- Association of Operating Room Nurses (AORN)
- Emergency Care Research Institute (ECRI)
- National Institute for Occupational Safety and Health (NIOSH)
- Occupational Safety and Health Administration (OSHA)
- State laws, manufacturer’s guidelines, and institutional policies and procedures

The National Institute for Occupational Safety and Health (NIOSH) is a federal research agency that carries out research and makes recommendations, but does not have regulatory authority. Based on the research of the mutagenicity of collected airborne compounds and the acute health effects reported by surgical personnel, NIOSH has concluded that exposure to electrosurgical-generated smoke is a hazard. NIOSH recommends protection against this hazard by utilizing engineering ventilation controls (smoke evacuation units) in order to minimize the acute health effects, reduce the
possibility for any chronic health effects, and to expel emissions that can diminish the surgeon’s field of view. 6

Since additional research has shown that surgical smoke and aerosol contain benzene, formaldehyde, HCN, and other harmful compounds, the agency recommends that the smoke be evacuated for procedures utilizing either ESUs or lasers. Furthermore, NIOSH advocate that the smoke evacuators be vented to the outside; that surgical personnel wear personal protective equipment (face shields and gloves) when maintaining smoke evacuators to avoid coming in direct contact with the accumulated material on filters and inner workings; and to evaluate and document any further acute and chronic health effects of surgical smoke and aerosol.

Two documents prepared by the Association of Operating Room Nurses (AORN) address the hazards of surgical plume – their “Recommended Practices for Electrosurgery” and “Recommended Practices for Laser Safety in the Practice Setting.” Although AORN’s recommended practices are not backed by law, they are intended to represent what is held to be an optimal level of perioperative nursing practice. Recently, a lawsuit was settled in which the court resolved that the AORN Recommended Practices are the criterion by which the perioperative profession will be judged.

AORN’s “Recommended Practices for Electrosurgery” identifies that exposure to electrosurgically-generated smoke has hazards and that “patients and perioperative personnel should be protected from inhaling the smoke generated during electrosurgery.” Protective measures include using smoke evacuation systems, with the position of the suction tubing as close to the source of smoke as allowable, thereby maximizing the amount of smoke captured and improving the visibility at the surgical site. AORN makes similar suggestions for laser-generated plume, stating “patients and health care workers should be protected from inhaling the plume associated with laser use.” 7

The Emergency Care Research Institute (ECRI), a nonprofit health services research organization, contributes technical assistance and information to the healthcare community to support competent and cost-effective patient care. ECRI recommends that smoke evacuators used at a surgical site should substantially capture the ECU-generated airborne particles. Furthermore, the ECRI suggests that the smoke from vaporized tissue be evacuated in order to minimize airborne hazardous particles that could deposit into the respiratory tracts of health care workers. 8

In September of 1997, NIOSH and the CDC issued a hazard alert to the 10,000 facility network personnel, advising that healthcare workers should protect themselves from inhaling this smoke. Draft guidelines have been completed by the CDC and NIOSH, and are now awaiting publication from the OSHA.

The American National Standards Institute (ANSI) is a private, non-profit organization that administers and coordinates technical standards for various industries. The Institute represents a consortium of more than 1,000 organizations across the U.S. whose mission “is to enhance both the global competitiveness of U.S. business and the U.S. quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems, and safeguarding their integrity.” The American National Standard for the Safe Use of Lasers (ANSI Z136.1-1996) distinguishes three major control measures obtainable to reduce the concentration of laser generated air contaminants to
permissible levels: respiratory protection, exhaust ventilation, and process isolation. The American National Standard for the Safe Use of Lasers in Health Care Facilities (ANSI Z136.3-1988) advises the use of a localized smoke evacuator equipped with HEPA and/or charcoal filters to remove airborne contaminants generated during most laser surgeries. Respiratory protection or masks are also recommended. Currently, there are no ANSI standards that address the hazards of smoke produced by electrosurgical instruments. 9

The only organization that has the force of law behind its regulations is OSHA. The General Duty clause entitles OSHA to cite employers for not providing “employment and a place of employment which are free from recognized hazards.” This clause allows OSHA to enforce an industry standard that regulates a recognized hazard.

One such standard is the respiratory protection standard (29 CFR 1910.134), allowing OSHA the authority to regulate smoke in the workplace. Under the current standards guidelines, OSHA expects employers to do a risk assessment on the surgical smoke and write a respiratory protection program. Engineering controls, such as ventilation systems and smoke evacuators, is the first line of protection. The next one is personal protective equipment. In addition, OSHA has constituted maximum allowable levels of occupational exposure to particular hazardous chemical constituents of surgical smoke and aerosol, based on the levels instituted by the American Conference of Government and Industrial Hygienists (ACGIH).

OSHA currently regulates laser plume only; electrosurgical smoke and aerosol are in the process of being regulated. During a conference in December 1995, representatives from OSHA, the Centers for Disease Control (CDC), and the National Institute for Occupational Safety and Health (NIOSH) agreed that smoke originating from electrosurgery was just as dangerous as the smoke originating from the use of lasers, and that this smoke should be evacuated to safeguard surgical staff and patients from its potentially hazardous effects. The CDC expressed its interest in conducting an official study to record the effects of exposure to surgical smoke and aerosol. NIOSH and OSHA are expected to publish revised policies on the necessity of evacuating both electrosurgical and laser smoke and aerosol.

Based on medical literature outlining the presence, infectivity, and viability of surgical smoke and aerosol elements, it may be inferred that smoke can contain bloodborne pathogens as stated by OSHA’s bloodborne pathogens standard. OSHA has determined that health care workers face a health risk as a result of occupational exposure to potentially infectious materials present in electrosurgical and laser plume. The bloodborne pathogens within the smoke plume are pathogenic micro-organisms that are contained in human blood and can cause serious diseases in humans. These pathogens include the human immunodeficiency virus (HIV) and hepatitis B virus (HBV), and may include other viruses. Hence, when health care workers are exposed to the plume, employers would be required to enforce universal precautions, provide personal protective equipment, and implement engineering controls and work practice controls. OSHA concludes that when electrosurgical and laser units are used in conjunction with smoke evacuation equipment to eliminate or substantially reduce the risk of contamination by bloodborne pathogens present in the smoke plume.
Comments taken from the new OSHA standard have concluded the following:

- The CDC reported 8700 cases of Hepatitis B infection (HBV) occurred among health care workers in the United States in 1988.
- As of May 1990, at least 65 case reports of healthcare workers associated their HIV infections with the occupational exposure to surgical plume.
- The new OSHA standard requires employers to furnish personal protective equipment (PPE) to all potentially exposed health care workers.
- Smoke Evacuation Systems are recommended during surgical procedures to reduce the risk of occupational exposure to bloodborne pathogens.

With all the concern surrounding the hazards of inhaling surgical smoke, it’s no surprise that numerous organizations have published research reports and articles outlining the importance of protecting medical professionals from this danger.

Although few of these studies have ascertained clinical harm to health care workers or patients from the exposure to surgical smoke and aerosol, their discoveries have been important enough to cause numerous experts to advocate implementation of techniques to reduce or eliminate the exposure to surgical smoke and aerosol.

A number of case studies have concluded the dangers associated with surgical smoke. These dangers include inhibition of tissue oxygenation, the Human Immunodeficiency Virus, the Human Papilloma Virus, mutation potential, lung disease, and other biological hazards.

Ongoing studies on the effects of electrosurgical smoke are being conducted by researchers at Washington University, St. Louis. In one study, the researchers measured particulate matter in electrosurgical smoke while performing breast reduction procedures. The OR filled quickly (within five minutes) with particulates when smoke evacuators were not used, and it took 20 minutes after electrosurgical device use ceased for the smoke plume to disperse through the hospital ventilation system. The same group of investigators sampled particle counts in several locations in the OR (i.e., ten feet, four feet, six inches from the smoke producing source). The maximum particle count was consistent throughout the OR, meaning both the surgeon and the OR observers were exposed to the same particle levels. However, particle concentration decreased significantly with the use of smoke evacuators throughout the same type of procedures.

Dr. Michael Baggish, a Chicago gynecologist and obstetrician, submitted a study in which cultured HIV cells were vaporized by an in vitro laser procedure, with the resulting laser plume being captured in the inner lumen of the smoke evacuation tubing. HIV proviral DNA, the virus responsible for acquired immune deficiency syndrome (AIDS), was contained in the captured smoke. Dr. Baggish concluded that HIV was present in the laser smoke and deposited inside the tubing.

There is also evidence that HIV-1 has been found in the plume generated by electrosurgical and powered surgical instruments.

Because of its pervasiveness in the general population, Human Papilloma Virus (HPV) is receiving quite a bit of attention. Jerome Garden, MD, recovered intact papilloma virus
DNA from the smoke produced by a carbon dioxide laser used to treat bovine and human warts. The papilloma virus has also been isolated from the smoke generated from treatment of bovine and human warts with electrosurgery. 13

Electrosurgical smoke and aerosol generated during routine reduction mammoplasty has been evaluated by NIOSH to determine its mutagenic potential. Glass-fiber filters were used to collect airborne particles, samples were extracted, and the standard Ames test was used on concentrated extracts to check for mutagenic activity in two strains of Salmonella typhimurium. The smoke was found to be mutagenic to one of the two strains. 14

Another study conducted by Japanese researchers sought to measure the mutagenicity of 40 mg of smoke produced when one gram of tissue was vaporized by an electrosurgical device or a carbon dioxide laser. The Ames test revealed that the mutagenicities of the electrosurgical and laser smoke and aerosol particles were comparable to that produced by three and six cigarettes. 15

These results come as no surprise, as it is known that broiling and frying meat releases mutagens. Neither study determined whether or not perioperative personnel are at a serious health risk from exposure to the smoke, but safe levels of ambient mutagens have not been resolved, and likely will not be in the near future.

Wenig et al. studied the results of Nd:YAG laser and electrosurgery plume in both contact and noncontact modes on the respiratory system of rats. Cardiorespiratory specimens and histologic analysis in all modes revealed emphysematous changes and alveolar congestion. 16

A study conducted by Baggish and coworkers analyzed the effects of carbon dioxide laser plume on the lungs of rats. They found Bronchiolitis, Congestive Interstitial Pneumonia, and Emphysema in the rat lungs that were exposed to laser plume for varied periods of time. As the duration of exposure to carbon dioxide laser plume increased, so did the severity of pulmonary pathology. 17

DesCoteaux et al. retrieved particles of human cell size (7.5 to 25 µm) and breathable aerosols (< 4.5 µm) from the smoke created during laparoscopic procedures that made use of an electrosurgical instrument. These somewhat large particles may be comprised of complete cells, which may harbor cancer or viruses, thus escalating concerns about the absorption of toxic matter or dissemination of cancer cells in such procedures. 18

This overwhelming amount of conclusive data proves that surgical smoke, generated from either an electrosurgical device or a laser, can have dire consequences on the health of OR personnel and any others that come into contact with the hazardous smoke. Practically every agency associated with health care worker safety recommends protecting personnel from inhaling these noxious fumes. The safest way to reduce the risk of the potential chronic long-term risks is to evacuate the surgical smoke directly at the source.

Numerous systems have been developed for aspirating the plume produced by electrocautery devices in electrosurgical procedures. In the typical technique, the plume is aspirated by a conventional hospital suction tube held near the site of the electrosurgical procedure by an assistant. Unfortunately, this method inefficiently requires the full-time attention of the assistant and the placement of the often bulky
suction tube in the operative field which can obstruct the operating surgeon’s view. Additionally, since conventional suction tubes create substantial noise levels in the operating room, coupled with the fact that the suction tubes operate on a continuous basis during surgery, the suction tubes interfere with normal operating room dialogue thereby potentially causing miscommunications and misunderstandings between the operating room surgeon and the operating room staff.

D3, LLC was formed to develop an electrocautery device that serves a dual purpose as a surgical tool and a vacuum port into a single ergonomic design. This revolutionary electrocautery instrument utilizes a suction switch feature that can evacuate cautery plume from the surgical site as it is being created without disturbing or altering the surgeon’s comfort or dexterity during use.

The self-evacuating electrocautery device is an electrocautery instrument for selectively providing electrical energy from an electrosurgical generator for alternatively searing and coagulating tissue and the like of a patient during surgery. The electrocautery device has a blade and a cable electrically connecting the blade to the electrosurgical generator.

This surgical tool comprises a main body and vacuum means associated with the main body for selectively providing a vacuum for removing any plume created while searing or coagulating tissue with the blade of the electrosurgical instrument. The surgical tool further comprises switch means secured to the main body for selectively controlling the electrical energy to the blade. The switch means selectively activate the vacuum means only upon activation of the electrical energy.

The vacuum means are comprised of numerous intake ports formed adjacent to the first opening of the hollow body. Vacuum tubing extends through the second opening of the hollow body and connects to the intake ports of a vacuum source for creating a vacuum, and a waste receptacle is connected to the vacuum tubing for receiving the plume. Furthermore, the electrocautery device comprises the switch means comprising a self-centering switch body rotatable within the hollow body to selectively activate the electrical energy of the electrosurgical generator to either sear or coagulate tissue and to activate the vacuum means upon activation of the electrical energy. The switch means further comprise path means formed in the switch body for selectively connecting the intake ports to the vacuum tubing upon activation of both the electrical energy to either sear or coagulate tissue and the vacuum means. The path means comprise a pair of intersecting airway paths alternatively alignable within the hollow body to connect the intake ports to the vacuum tubing upon activation of both the electrical energy and the vacuum means.

- The self-evacuating electrocautery device has the following advantages over existing electrosurgical devices:
  - Effectively removes the plume created during surgical operations to minimize health hazards to the operating surgeons and the other operating staff.
  - Does not unduly interfere with the operating surgeon’s field of view.
  - Does not interfere with the operating surgeon’s use of the electrocautery device as an electrosurgical instrument.
  - Activates a vacuum to remove the plume only during activation of the electrocautery device.
• Significantly reduces noise level (dB) in the operative theater.

The self-evacuating electrocautery device aspirates the hazardous plume without obstructing the operating surgeon’s view; with a non-obtrusive noise level, and only is used upon activation of the electrical energy without the necessity of an assistant.
References:

3. Winstin, C. The Effects of Smoke Plume Generated During Laser and Electrosurgical Procedures. Minimally Invasive Surgical Nursing 1994;8:3
5. Patterson, Pat. “OR exposure to electrosurgery smoke a concern.” *OR Manager* 9(June 1993): 1, 6-7.
15. Patterson, Pat. “OR exposure to electrosurgery smoke a concern.” *OR Manager* 9(June 1993): 1, 6-7.