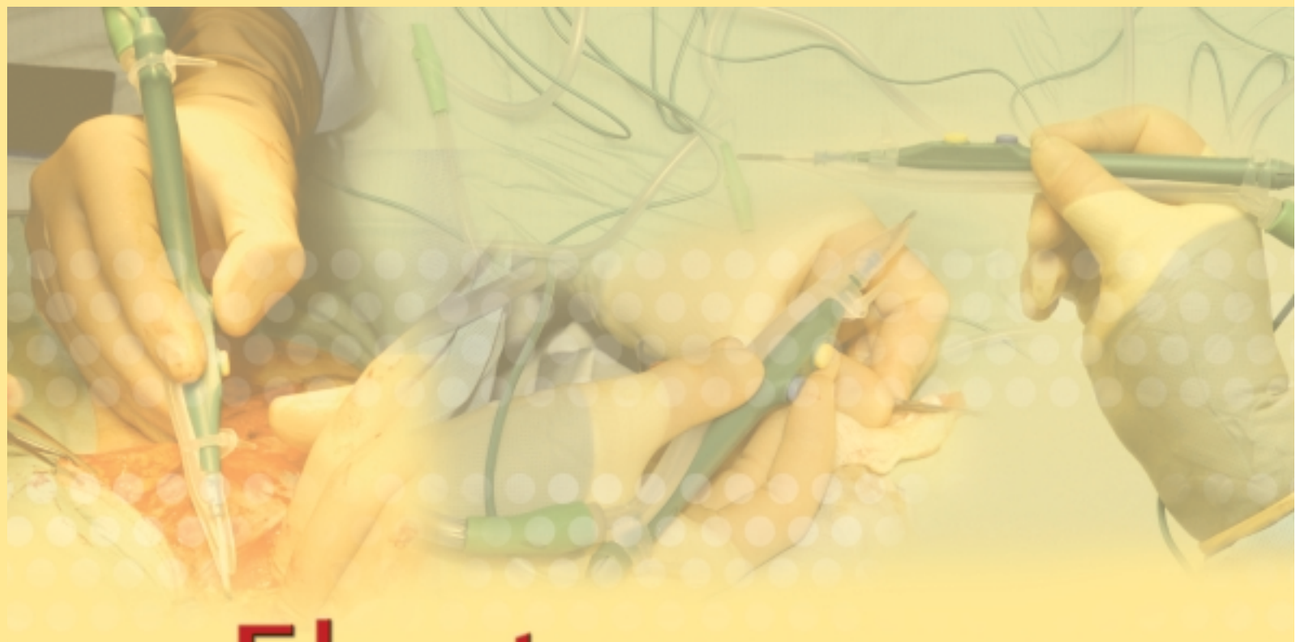

Electrosurgery

Managing the Risk

This poster aims to give an overview of electrosurgery in the perioperative setting. This will be achieved by identifying and defining some of the common forms of electrosurgery used in perioperative practice and will identify some of the hazards that can be associated with these products.

The following recommendations were reviewed and developed by the NATN Practitioners' Panel.

NATN gratefully acknowledges the support of Felicia Cox and Paul Wicker in contributing to this poster.

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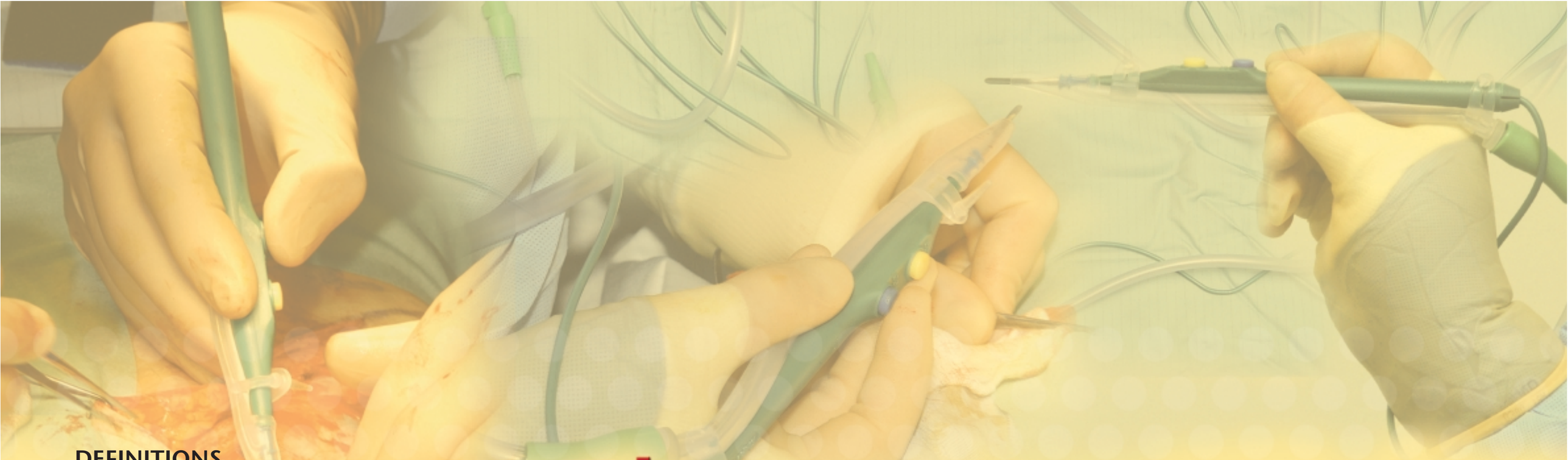

Electrosurgery

Managing the Risk

DEFINITIONS

Electrosurgery (diathermy) is defined as 'the cutting and coagulation of body tissue with a high frequency (ie, radio frequency) current' (AORN 2004).

Monopolar Diathermy

The passage of a high frequency current which passes through the patient from the live or active electrode (diathermy forceps or pencil) to the return electrode. Return electrode is also known as indifferent electrode, patient electrode or diathermy pad. Where the flow of the current is resisted in body tissue, there is a localised rise in temperature which will create a high enough temperature to produce the relevant effect of coagulation or cut.

Bipolar Diathermy

In bipolar diathermy, the active and return electrodes are combined within the diathermy forceps and the current passes between the two points which are both separated with insulating material. Bipolar diathermy is perceived to be safer as the current pathway is much shorter than that utilised in monopolar diathermy. Bipolar diathermy is generally utilised in the following situations:

- When coagulation only is required
- When coagulation is required in peripheral areas of the body such as hands or feet or other areas where 'channelling' may occur
- In procedures where pinpoint or micro coagulation is required
- When a patient has a pacemaker in situ

Ultrasound

In addition to electrosurgery and diathermy, ultrasound equipment can also cut or coagulate tissue using high frequency sound waves, for example, the UltraCision instrument or Harmonic Scalpel from Ethicon Endo-surgery, Ligasure from Tyco Healthcare or the Radiofrequency Vapouriser from Mitek. These facilitate the transformation of electrical energy into mechanical energy, and this transformation usually occurs in the hand piece following activation of the footswitch by the user. Coblation is a type of ultrasound used within a conductive medium such as saline. Ultrasound equipment is designed for both open and laparoscopic procedures.

Electrosurgery Explained

Electrosurgery requires an electrosurgical generator which produces the radio frequency current, cable and active electrode and a return plate or indifferent electrode for the use of monopolar diathermy. Bipolar diathermy uses the same items with the exception of the return or indifferent electrode as it is not required. The electrosurgical generator or unit can produce three distinct surgical effects, known as fulguration, dessication and cutting. The electrosurgical generator creates different wave forms which are determined by the setting on the machine, universally known as COAG, CUT and BLEND. The settings and desired effects are linked as follows:

1. Dessication and COAG: The COAG waveform consists of bursts of radiofrequency, which when used on low power create the effect known as Dessication. Dessication is defined as a relatively slow drying out of tissues by current that does not produce sparks which in turn leads to coagulation
2. Fulguration and COAG: When the COAG waveform is used at a high power setting it will create the effect known as fulguration. The high power generates sparks which create intermittent heating of tissue causing cells to dry out quickly rather than explode into steam.
3. Cutting: The CUT waveform is a continuous waveform at a lower voltage but higher current than COAG. This creates a high density of current in a specific tissue area within a short period of time. This results in cell explosion due to the localised but intense heat.
4. Blend: This is a combination of CUT and COAG and is used where haemostasis is required as tissue is cut.

Hazards of Electrosurgery

There are a number of hazards that can be identified in relation to the use of electrosurgery in the perioperative environment, and it is important to be aware of these in order to minimise the risk of adverse incidents.

Accidental Burns

The source of an accidental burn is often linked to the return electrode.

Some burns are found directly below the return electrode and are associated with a failure of the electrode. This problem has largely been eliminated due to the development of Contact Quality Monitors (CQMs) and Return Electrode Monitor (REM) plates. These systems are designed to monitor the patient to pad interface. Many return electrodes are now single use and consist of a dual pad that is adhesive. Within the electrosurgical unit, there is a monitoring unit which in the event of the patient's electrode pad being ineffective, will sound an alarm and cut the current, thus reducing the chances of a burn. The cause of ineffectiveness may be due to the pad being positioned incorrectly or not fully in contact with the patient as well as the possibility of a defective pad.

In the event that the desired effect is not achieved on normal settings, all equipment should be checked prior to increasing the power to minimise the risk of accidental burns to either the patient or the surgeon.

Care should also be taken to ensure that the live electrode is stored in an insulated container away from the operative field, when not in use.

All equipment should be checked before and after use and there should be a system in place whereby the accurate number of usages of reusable equipment such as cables and forceps is recorded.

Another source of accidental burns occurs when an alternative pathway has been found. Alternative pathways occur when the current is diverted from the return electrode and finds an alternative path from the patient to the 'ground'. In an isolated generator 'ground' represents the negative phase of the isolation transformer within the electro-surgical generator. In an 'earthed' generator, 'ground' represents the common earth of the mains electricity system. If the point of contact between the patient and the grounded object is small, sufficient current density can be generated to cause a burn. The most likely alternative pathway is created by the patient coming into contact with a metal part of the operating table, a table accessory or an ECG electrode. This problem is reduced but not eliminated by the use of isolated electro-surgical units which have little or no reference to 'earth', although it is pertinent to be aware that earthed referenced currents can still be produced from isolated units in certain circumstances. **However, it is pertinent to be aware that earthed generators are still available from some companies for use in specialised applications.** Another source of an alternative site burn is one that is due to 'leakage current'.

Surgical Plume

This is the name given to the vapour containing particles that are released when an electrosurgery, laser or ultrasonic device is used on body tissue. There is evidence to suggest that the content of this plume could contain toxic chemicals, carbonised tissue, blood particles, viral DNA particles, bacteria and carbon dioxide to name but a few. As a result of this it is recommended that specific smoke evacuators with Ultra Low Penetrating Air Filter (s) are used to remove this plume from the perioperative environment.

NATN recommends:

- **All thermal instruments used in surgery produce smoke which potentially contains infective agents that may be hazardous to staff**
- **Dedicated smoke evacuators must be used and the filters checked and changed as per the manufacturers recommendations**
- **Piped or free standing suction units must not be used for smoke evacuation as they do not have particulate filters**
- **High filtration face masks should be worn in all procedures that produce surgical plume to minimise the inhalation of carbonaceous particles**

Minimal Access Surgery (MAS)

MAS has specific hazards in relation to electrosurgery. These hazards are primarily related to the number of instruments and cannulae within the operative field. The principle hazards associated with these procedures are:

- Direct coupling which occurs when an active instrument touches an inactive one
- Capacitive coupling which occurs when current is conducted from one instrument to another where there is no direct contact
- Insulation failure where breaks in insulation materials are not noticed prior to use.

All of the above may lead to accidental burns to patients undergoing MAS.

Endoscopic Surgery

Endoscopic surgery utilises metal instruments in confined spaces, thus increasing the risk that an active electrode will come into contact with a metal endoscope, resulting in a burn for either the patient or the surgeon. There can be occasions when endoscopic electrosurgery is deemed to be of a lower power than other electrosurgery and thus less harmful. Clinical evidence may suggest otherwise, particularly in view of Medicines and Healthcare products Regulatory Agency (MHRA) alerts on these types of products (MDA 2002, MHRA 2003).

Other Hazards Associated with Electrosurgery Include:

- **Interaction with skin preparations and other alcohol based or aerosol products used within the perioperative environment. The pooling of alcoholic prep solutions must be avoided due to the possibility of ignition. This type of skin prep should be allowed to dry or be dried with a surgical swab, prior to the start of any surgical procedure (MDA2002).**
- **Interference with other medical devices such as pacemakers, ECG machines and video equipment used in MAS**
- **Accidental electrocution of the patient or staff with low frequency mains electricity**

Risk Assessment and Health and Safety

In view of the hazards outlined above, it is clear that this is an area of practice which must be subject to robust risk management and safe systems of working.

Risk Assessment can be defined as the process of identifying what in the workplace has the potential to be a risk and, how to minimise that risk. There are five basic steps to risk assessment:

1. **Identify the hazards**
2. **Identify who may be harmed and how**
3. **Evaluate the risks by assessing existing precautions and identifying a new one if necessary**
4. **Record your actions and observations**
5. **Review your assessment at regular intervals and revise as necessary**

Health and Safety legislation requires employers to address the following:

- **Provide safe systems of working**
- **Prevent or control exposure to substances which may damage your health**
- **Ensure adequate precautions are in place to minimise the dangers of explosive or flammable materials as well as electrical equipment, noise and radiation**
- **Provide adequate supplies of any type of protective clothing (PPE) or equipment requirements.**

These requirements demonstrate the need for a robust policy relating to the use of all electrosurgery equipment in the perioperative setting, in relation to Risk Management, Health and Safety Laws and the Clinical Governance framework.

The same laws also place an onus in the employees to comply with local policies and procedures as these constitute a safe system of work. Employees are also required to observe policies on the use of PPE in accordance with any training on the use of PPE.

In conclusion, it can be seen that electrosurgery is an essential part of perioperative practice. However, every practitioner in the perioperative environment needs to have a working knowledge of the principles of electrosurgery and an awareness of the potential hazards if the risks to patient safety and other members of the perioperative team are to be reduced.

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