Laparoscopic Surgery and the Care and Handling of Laparoscopic Devices

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LEARNING OBJECTIVES

1. Review laparoscopic surgery and the types of laparoscopic devices available for use
2. Discuss the differences between monopolar and bipolar electrosurgery and devices
3. Review the care and handling recommendations for laparoscopic devices

Surgery has historically been performed through open surgery. Since the late 1980s, however, minimally invasive surgery (MIS) has been a growing trend as a preferred surgery option, and more surgeons are using this approach. MIS procedures allow for reduction in the size and number of access sites, specific to the abdominal cavity when performing laparoscopic surgery.

This lesson plan discusses minimally invasive laparoscopic surgeries. It is imperative that all members of the laparoscopic team involved in the care, handling and processing of laparoscopic instruments know and implement proper processing procedures.

Objective 1: Review laparoscopic surgery and the types of laparoscopic devices available for use

Laparoscopic instrumentation has evolved over time. The original laparoscopic devices could not be disassembled and were very difficult to clean. The next generation included irrigation ports to help make it easier to clean the instruments' lumens. The addition of ports improved the cleaning process, but the instruments were still very time-consuming and difficult to clean, especially when manual cleaning methods were used.

The third generation of laparoscopic devices has evolved further, and many of these devices can be partially or fully disassembled for more efficient cleaning of lumens and small crevices. However, care is still needed to ensure that these parts are reassembled correctly and that the instrument functions properly after cleaning.

Laparoscopic surgical techniques are as effective as open surgery and have the following advantages:

- Reduced hospital stays due to the less invasive process and smaller incisions. Many laparoscopic cases result in the

patient's discharge the same day of surgery.
- Fewer blood transfusions are typically needed.
- Reduced post-operative pain. Smaller surgical scars on the body, both internally and externally, result in less pain.
- Decreased chance of internal surgical infections. Since internal organs are not exposed to possible contaminants in the outside air, there is less chance of internal surgical infections. Smaller wounds typically result in fewer complications and infections.
- Earlier return to normal activity or work.

Although laparoscopic surgery has many advantages, there are also some disadvantages and risks. Some are common to all types of surgery, including reaction to or problems with anesthesia, excessive bleeding, infection, or delayed healing caused by swelling, bruising or comorbidities. *Note: Comorbidities occur when there is one or more co-existing medical condition or disease process in addition to the initial diagnosis.*

Other complications that may occur are specific to laparoscopic surgery. For example, in traditional laparoscopic surgery, the surgeon has a limited range of motion, so it can be difficult to maneuver the instruments, tissue and organs. It can also be a challenge for the surgeon to perceive depth properly, and the surgical tool's endpoints move in the opposite direction of the surgeon's hands. Moving the instruments is, therefore, not intuitive and takes more time to learn. Additionally, the surgeon is working with reduced or without tactile sensation, and this may cause them to use more force than needed, which can result in tissue damage.

There are various types of laparoscopic devices in the marketplace, including reusable, disposable and reposable (part-reusable, part-disposable) instruments. Reusable instruments can be sold as a complete device or purchased as individual components. The instrument, if modular, usually consists of a jaw insert, insulated outer tube and handle. Different types of handles come with laparoscopic instruments. The two standard types are with or without a ratchet. Disposable instruments come packaged sterile as a complete instrument with or without a cord. They are standard-use instruments, which can also be insulated to the tip. They are packaged in different box sizes depending on the manufacturer. Reposable instruments have a disposable component, usually the shaft, and a reusable component, the handle. These devices combine the convenience of a single-use instrument with the cost savings of a reusable product.

Laparoscopic instruments are available in various lengths and sizes. The lengths range from 20–29cm for short/mini or pediatric devices to 31–37cm for standard devices and 37–42cm for bariatric devices. The instrument diameter can be 3.5mm (mini), 5mm (standard) or 10mm (bariatric).

Different types of instruments are used in laparoscopic surgery: scissors, hooks, graspers, needle holders and a wide range of specialty instruments. It is important to remember that certain instruments can be heavy and have delicate tips. When putting these instrument sets together, it is critical to keep the weight of the sets reasonable, following the industry standard of a maximum weight of 25 pounds for containerized sets. In some instances, a single laparoscopic set may require multiple containers.

Broadly speaking, laparoscopic instruments can be divided into two major categories: (a) equipment and instruments for access and exposure and (b) instruments used to perform the actual surgical procedure. Many instruments used to perform laparoscopic procedures are very similar to general handheld surgical instruments and are classified in a similar way.

Equipment for access and exposure includes the laparoscope, camera, light source, television or video monitor, insufflator, CO_2 cylinder, suction irrigation machine and ancillary equipment. A variety of cables and tubes connect the different machines and instruments. The cables, cords, instruments and equipment present on the sterile field must be decontaminated and sterilized between uses.

Laparoscopic instruments are used in the many of today's surgeries, including:
- General surgery
- Bariatric surgery
- Gynecology
- Colorectal surgery
- Urology
- Hepatobiliary surgery
- Thoracic surgery

Common procedures performed laparoscopically include:
- Cholecystectomy: removal of the gallbladder
- Appendectomy: removal of the appendix
- Hysterectomy: removal of the uterus
- Nephrectomy: removal of the kidneys
- Gastrectomy: total or partial removal of the stomach (sleeve gastrectomy or bowel resection)

Objective 2: Discuss the differences between monopolar and bipolar electrosurgery and devices

Many laparoscopic instruments have a cautery post to deliver electrosurgical energy to the instrument's distal (furthest) end. This allows for cutting soft tissue and stopping bleeding from small blood vessels. The instrument shaft is insulated to ensure that energy does not escape and cause unintended harm to non-affected tissue. Nicks and cuts in the insulation can cause burns to tissue and organs in the abdominal cavity. This damage can go unnoticed because the surgeon is concentrating on the instrument's operative tips, or the damage may occur outside the surgeon's range of vision. In rare cases, the patient's stomach or intestines may be perforated which can lead to peritonitis.

The purpose of electrosurgery is to produce heat by concentrating electric current at target tissues to achieve desired results. The smaller the area of tissue-instrument contact that concentrates the current, the more resistance is built and more voltage (the force pushing electric current through the resistance) is required to move the current through the limited space. There are two basic types of electrosurgery:

Monopolar – The monopolar circuit includes a generator, instrument, active electrode, patient and patient grounding pad. The active electrode instrument is placed in the entry site and used to cut tissue and coagulate (seal) bleeding. A grounding pad (return electrode) is attached to the patient, and the high-frequency electrical current then flows from the generator to the instrument through the patient to the grounding pad and back to the generator. Monopolar electrosurgery is popular because this type of energy is very versatile and effective. Monopolar generators typically produce outputs of 1 to 300 watts of energy in cut modes and 1 to 120 watts in the coagulation mode. Laparoscopic instruments are the most frequently used devices for monopolar electrosurgery.

Bipolar – Bipolar devices contain both the active and return electrodes, which means the active output and patient return functions both occur at the surgery site. The path of the electrical current is confined to the tissue between the two electrodes that are contained in, for example, the bipolar instrument's forceps. Bipolar electrosurgery requires less energy and allows the use of lower voltages. However, it has limited ability to cut and coagulate large bleeding areas, so it is ideally suited for coagulation of small arterial or venous blood vessels to control blood loss. Bipolar generators produce 1 to 80 watts of energy. These instruments can be configured as cutting and/or grasping tools, and they are made of a tubular shaft (lumen) with two jaw parts located at the distal end. The jaw parts are constructed of a metallic material and coupled by a joint. Electrical connections in the bipolar device generate a high-frequency electric current which increases the cutting effect when a cutting tool is used, and the coagulation of tissue contacted when a grasping tool is used. Electrical current passes from one side of the instrument jaw through the tissue to the other side of the jaw, then back to the generator.

All electrosurgical instruments should be tested for broken insulation and electrical leakage each time the device is processed.

Objective 3: Review the care and handling recommendations for laparoscopic devices

Reusable laparoscopic instruments that are not properly cleaned and sterilized are a major cause of surgical site infections (SSIs). Proper device processing is critical not only for patient safety and positive surgical outcomes but to prevent damage to the instrument and maintain its useful life.

Basic cleaning equipment and accessories used for cleaning laparoscopic instruments should include:

- Accessories or adapters for connections for instruments and equipment
- Cleaning chemicals and lubricants
- Brushes for cleaning each device's shaft, ports, jaw and lumens
- Each device manufacturer's instructions for use (IFU)
- Mechanical equipment required by the IFU

All laparoscopic instruments have to be maintained to retain optimal functionality. Preventative and routine maintenance are essential to keeping laparoscopic devices in good working condition. Functional testing during device processing is key to finding instruments that need to be removed from a set and sent out for repair or replacement.

Immediately following any laparoscopic procedure, point-of-use treatment should be performed as quickly as possible following each manufacturer's IFU. Laparoscopic devices should then be placed in their specific instrument tray and secured for transport to the decontamination area.

During the sorting process in the decontamination area, instruments

should be quickly checked for obvious damage. The point-of-use spray or foam should be rinsed from each instrument. Instruments should be disassembled, if possible, and soaked per the IFU. After the pre-soak, instruments should be rinsed, the lumens brushed and flushed per the IFU, rinsed again, and then either manually cleaned or placed in the appropriate mechanical cleaner. When irrigating the lumens, be sure to use the correct adaptors and run the appropriate mechanical cycle.

During assembly, cleaning verification (CV) testing should be done following the facility's policy. Each instrument needs to be carefully checked for cleanliness, dried, assembled and tested for function. Insulated instruments need to be carefully checked for damage and leak tested. Sharp devices should be tested for sharpness as recommended by the manufacturer. Lubricate per the IFU. Devices should be disassembled and carefully placed inside the appropriate containment device. These devices are easily damaged so be sure they are adequately protected. The use of tip protectors, laparoscopic instrument racks or other approved protection devices is encouraged as needed.

Instruments should be packaged then sterilized following the IFU, being careful that the appropriate sterilizer model and cycle are used to avoid damage. Handle the sterile device by lifting, not dragging, the tray, do not stack unless stated in the IFU, and transport carefully, being sure the devices are placed securely on the transport cart.

Conclusion

Laparoscopic devices require careful attention and handling. It is critical that all members of the surgical team handling laparoscopic devices do so in a way that is safe and effective for patients and other colleagues in the hospital setting. Careful attention to detail, testing, cleaning, packaging and transport will help these devices have a long, well-functioning life. P