Radio Surgery for Minor Operations in General Practice

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The use of a radiosurgical unit in general practice has shown many advantages over conventional surgical techniques — particularly for dermatological, plastic and eyelid surgery. Quicker operating time, rapid healing, less tissue damage and less post-operative discomfort have been observed, and its wider use in hospital practice is recommended.

The use of electrical currents in medicine have been documented almost since electricity itself was discovered; earliest accounts used low-voltage direct currents to heat electrocauteries, and to pass chemicals through the skin (lontophoresis). Very high-frequency electrical currents and voltages were used for a wide variety of treatments at the beginning of this century (auto-condensation, fulguration, desiccation, etc.) Low-frequency alternating currents were used in physiotherapy for their ability to cause contractions in muscle fibers, and about the same time, with the invention of the electrical transformer, together with circuitry to produce currents of varying frequencies, equipment which produced very high electrical frequencies and very high voltages was developed. It was noted early in the research that alternating currents above a certain frequency ceased to produce muscle contractions, resulting in the now familiar hospital diathermy equipment, whereby an electric current is passed through the patient and the heat generated used both for cutting and coagulation.

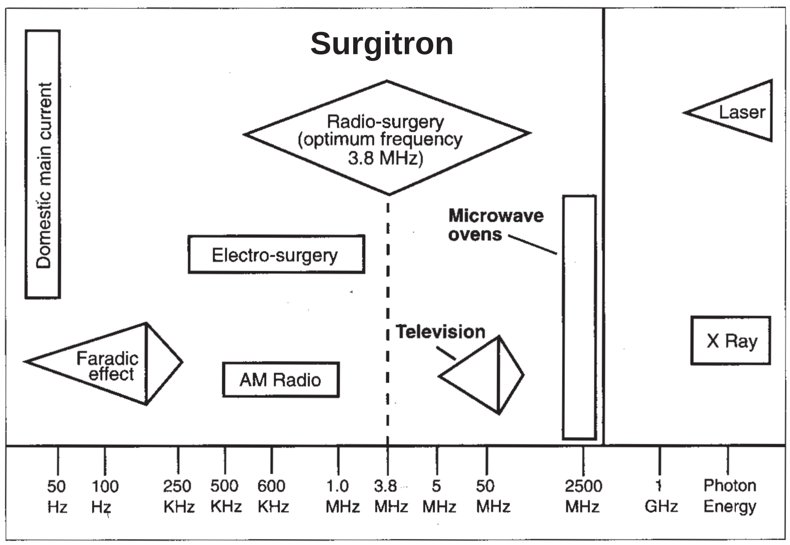

Fig. 1: Range of frequencies used in different applications.

Radiosurgery, not to be confused with electrosurgery, diathermy, spark-gap circuitry, or electrocautery, uses a very high frequency radio-wave — 1.5-4.5 MHz — (Fig. 1), a plastic-covered ground-plate or antenna, and a fine needle or loop 'patient electrode' which is held by the surgeon. No electrical contact needs to be made between the patient and the ground-plate, unlike operating-theatre diathermy equipment. Radio energy passes between the ground plate and patient electrode; it is concentrated at the needle end or wire-loop electrode, resulting in the release of energy, which produces steam within the cells, thus vaporizing them and dividing the tissues. Unlike electrocautery or diathermy, the needle or loop electrode remains cold. The power settings with radiosurgery are fairly critical. If too low, the electrode will stick and drag; if too high, sparking and tissue damage will occur. The optimum power setting is such that there is no drag and no sparking and the electrode glides smoothly through the tissue. Histologically, it can be shown that tissue damage with radiosurgery is actually less than with a conventional scalpel.

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The Radiosurgical Unit

All radiosurgery units (Fig. 2) comprise a transformer to change the main voltage of 110/240 AC 50/60 Hz to a high voltage and high frequency (1.5-4.0 MHz). This high frequency current is then further modified by filtering and rectification to produce one of four waveforms viz: fully filtered - suitable for cutting - produces least lateral heat; fully rectified - suitable for cutting but also produces lateral heat to coagulate; partially rectified modu-

Fig. 2: The Ellman Surgitron Dual Frequence radio-surgical unit.

lated - suitable for coagulation bleeding vessels; and fulguration - spark-gap waveform - produces dehydration and superficial. The author used two previous radiosurgical units — the Ellman Dento-surg 90 watt instrument, and the Surgitron FFPF 140 watt machine — for 3 years and found them to be excellent for minor surgical procedures (Ellman International, Oceanside, NY)

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Both operated at a frequency of 3.8 MHz and incorporated a thermionic valve in the output power circuits. This year, an improved version of the radiosurgical unit has been introduced to the UK. The Ellman Surgitron TM IEC unit meets all electrical and safety standards covered by IEC 601-1, IEC 601-2-2, UL 2601 (USA) and CSA 22.2601 (Canada). This unit produces output power of 100 watts at 1.7 MHz without the need for a thermionic valve, at the four standard settings with a digital display and audible signal to indicate when the unit is activated.

As with all radiosurgery machines, smoke is produced, which needs to be removed to avoid the unpleasant smell of burning. This is achieved by an assistant-held vacuum extractor, which also incorporates a viral filter and an activated charcoal filter for both operator and patient safety and comfort.

Precautions Using Radiosurgery

There are three precautions one must consider when using this form of surgery. Radiosurgery should not be used in the presence of inflammable anaesthetic vapors, liquids, or skin preparations. The surgery may present a hazard to patients with pacemakers, particularly earlier models (it would be wise to check with the patient's cardiologist). In addition, radiosurgery may interfere with the functioning of other electromedical equipment.

Technique

Clearly, there is a tremendous learning curve with radiosurgery. The surgeon must forget all skills acquired with scalpel surgery, and develop a completely new technique combining the following measures. No pressure must be applied; the radio energy does the cutting. Very light, delicate, smooth movements must be used — fairly quick strokes give better results. Power settings must be found by trial and error. Tissues must be kept moist - this means wetting with a gauze swab soaked in saline or water before starting. Dry tissues cut poorly. The current needs to be activated before contact with the patient. The only way radiosurgery can damage tissues is if heat is allowed to build up within tissues to a point where excessive dehydration occurs, whereby the tissue is then destroyed.

The production of "lateral heat" depends on this formula: Lateral heat = Time x Intensity x Waveform x Surface x Frequency.

Need to Know

The following are some tips and phrases vital to this procedure:

Electrode contact time: The slower the passage of the electrode, the greater the heat. The quicker, the less heat.

Intensity of power: Too high - increased heat and sparking. Correct - minimum lateral heat. Insufficient - dragging, causing increased heat and increased bleeding.

Electrode surface area: The larger the electrode, the greater the heat and the need to increase the power setting. The thinner the electrode, the less heat and less power needed.

Waveform: "Cutting" waveform - least heat. "Haemo" - some lateral heat. "Coagulation" - most lateral heat.

Frequency: The higher the frequency, the less lateral heat produced.

Learning radiosurgery: Using a piece of beefsteak, the doctor can practice most radiosurgery techniques, including cutting, biopsy, and coagulation.

Electrode sterilization: The active part of the electrode is self-sterilizing in use, and the tissue being cut will also be sterilized when the electrode is applied. This is a big advantage over conventional scalpel blades where cross-infection can occur.

Steam-cleaning electrodes: A simple method of steam-cleaning electrodes is by turning up the power, holding a folded wet gauze swab in one hand and lightly drawing the electrode between the gauze while activating the unit. Sparking and steam occurs, which effectively cleans the electrode.

METHODS

Dermatology - Intradermal Melanocytic Naevi

Good results have always been obtained by conventional shave/plane and cautery, but even more impressive results are obtained using radiosurgery, with less operating time, less tissue damage, less post-operative discomfort, quicker healing, and superior cosmetic results.

A tungsten wire loop electrode is used - the size of the loop is chosen to match the size of the naevus. The procedure is then as follows:

1. The boundary of the naevus is marked using a felt-tip pen. This is because the edges become slightly distorted when local anesthetic is infiltrated and it will be easier to see when the true edge is reached when removing the lesion.
2. Local anesthetic is infiltrated around the naevus. Some surgeons infiltrate actually into the center of the naevus.
3. The radiosurgical unit is switched on, the power settings for both cutting and coagulation chosen, and a wire-loop selected and inserted in the handle. Latex gloves should be worn, but they need not be sterilized.
4. Using a gauze swab soaked in normal saline or water, the naevus is wetted.
5. The unit is activated - the vacuum extractor is switched on, and the loop passed smoothly and fairly quickly through the naevus, just above the base. (Fig. 3-5)
6. The piece of naevus removed is then put in formol-saline and labelled, to be sent for histological examination.
7. There is now a short 'stump' of naevus left which is slightly proud of the surrounding skin - this may now be carefully planed down with very light feathering strokes until it is flush with the skin, or very slightly below it. Carbonized debris is wiped away using the wet swab.
8. Any bleeding vessels may now be coagulated by changing the electrode to a ball-ended applicator and using the coagulation current.
9. A cotton swab with 20% aluminium chloride in spirit is now applied if thought necessary to control any capillary oozing, remembering that this solution is inflammable.
10. A spot-plaster is now applied and the patient is given a post-operative information leaflet.

Dermatology - Incisions

Using a needle electrode as a scalpel, remarkably precise cutting can be obtained with the radiosurgery unit. The manufacturers produce a 'vari-tip' electrode that has a fine tungsten wire inside an outer sheath; this can be pulled out to the required depth of cut. The skin preparation is exactly as above, but the cutting action needs to be very smooth, quite quick and even, with no hesitation - the tissues literally 'fall-apart' with the advancing needle, and at the same time, small vessels are coagulated. Once the skin has been incised, any deeper dissection can be done with the 'cut/coag' waveform, which will seal off larger blood vessels.

Any larger vessels may be coagulated using a pair of bipolar forceps connected to the coagulation output of the radiosurgical unit. The skin edges are exactly perpendicular if the needle has been applied correctly, making subsequent approximation and suturing exceptionally easy. Because the cells on either side of the incision are coagulated, histological interpretation becomes much easier, and there is a theoretical advantage when excising possible skin malignancies of preventing lymphatic and blood-vessel spread. The wound may be sutured in the normal way using Prolene (Ethicon, Somerville, NJ) supported with subcutaneous absorbable sutures, if needed.

The Surgitron IEC has been used primarily for dermatologic minor surgery, but there are now hundreds of papers worldwide describing the use of radiosurgery in almost all specialities. In the UK, gynecologists have been using a similar instrument for wire-loop excision biopsy of the cervix and are thus familiar with this type of surgery. Other uses are the following:

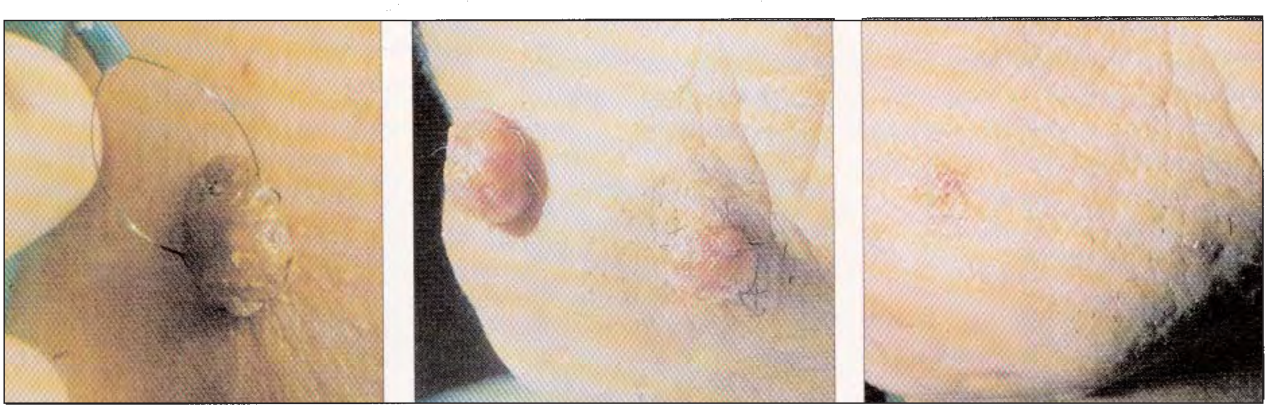

Fig. 3: Removal of raised intradermal melanocytic naevus using wire loop.

Fig. 4: Patient with fibroepithelial polyp on chin.

Fig. 5: The same patient 6 weeks later.

Plastic surgery: Breast reconstruction, face-lift, excision skin lesions, blepharoplasty.

Eyelid surgery: Excellent results have been obtained removing seborrheic keratoses from the upper eyelid, and there are many papers describing blepharoplasty and similar procedures on eyelids (see Further Reading).

ENT: Radio-assisted uvulopalatoplasty, removal of vascular lesion within the mouth.

General surgery: Simple incision/biopsy is very simple to perform as described earlier. Varicose veins, including thread veins, have been successfully treated.

Podiatry: The excision of plantar fibromata, verrucae, and ingrown toenails have all been widely documented with good results. Many surgeons now use nail matrix phenolization for the management of ingrown toenails; instead of applying a phenol swab, an insulated nail electrode can be used and the germinal epithelium destroyed using the coagulation current. Our experience is that this can be very quick, gives faster immediate postoperative healing, but with a slightly higher recurrence rate. We believe this was due to our inexperience, as cure rates in excess of 98% have been reported.

Vasectomy: The author has not yet used the radiosurgery unit for vasectomy, but several papers have described successful techniques for this operation using the cutting waveform to incise the scrotal skin, and the coagulation waveform to destroy and seal the vas.

Conclusion

The Ellman IEC Surgitron Radio-Surgery unit has a valuable place both in hospital and general practice. It offers considerable advantages over conventional surgical techniques; is quick, simple, effective and very cost-effective.

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