THE CHARTERED SOCIETY OF PHYSIOTHERAPY

Guide Lines for the Safe Use of Continuous Shortwave Therapy Equipment

Safety of Electrotherapy Equipment Working Group
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1. Introduction

Most shortwave therapy apparatus uses electromagnetic radiation at a frequency of 27.12 MHz (11 metres). This frequency is near to that used for CB radio communication and this fact, perhaps, indicates the difficulty of containing the radiation to a specific region of space, or tissue. The power output of the equipment should not be more than 500 watts and is considerably less than this under normal operating conditions. Some manufacturers provide equipment operating at 434.92 MHz although this is relatively uncommon and should be classified as microwave equipment.

The radiation can be either continuous or in the form of pulses. Pulsed mode operation is the subject of a separate document.

2. Equipment Testing Prior to Acceptance

2.1 *Electrical safety* to the standards laid down in BS5724: Part 1, General Requirements for the Safety of Medical Electrical Equipment[1] or equivalent standards, and in BS5724: Section 2.3, Specification for Short Wave Therapy Equipment[2] or equivalent standards, should be confirmed either by the supplier or, preferably, in the hospital or clinic by suitably trained hospital physicists or engineers.

2.2 *Output function* should be assessed as indicated in section 3. It may be noted that less stringent regulations exist for equipment generating less than 10 watts of power.

3. Calibration

Calibration of radio frequency fields is not easy, as the measuring device will often affect the field being measured. The output of a shortwave machine used for physiotherapy will be altered according to the way the applicators are positioned around the patient. However, there are aspects of calibration which should be undertaken on acceptance and at periodic intervals thereafter using appropriate specialised equipment[2, 10, 12].

31. *Frequency of operation* should be centred on 27.12 MHz, within the band 26.957-27.283 MHz. Radiation from the equipment, which can cause interference to other equipment should be limited in strength to less than 50 μV/m at a distance of 100 m from the equipment[3]. An rf frequency meter can be used to check frequency compliance.

3.2 *Output power* is normally indicated on the front panel of the machine. This usually refers to the drive conditions of the generator, rather than to the power actually delivered to the patient. BS5724, part 2.3, describes techniques for measuring the output of the equipment[2]. Modern equipment may have methods of measuring the power actually being delivered to the load (patient); this of course relies on prior calibration.

In the case of capacitive coupling systems a resistive load can be applied in place of the patient and the power (voltage and current) delivered to the resistor can then be measured.

In the case of inductively coupled systems it is suggested that inductive coupling to a resistive load using a tuned circuit should be used.

Commercial 'dummy loads' are available for use in the above measurements and will give a reasonable indication of actual output from the applicator, provided that proper matching is achieved.

Time variations in the output power through, for example, temperature changes, and modulation of the output waveform can be examined with an oscilloscope connected to the rf frequency meter (wavemeter).

3.3 *Timer accuracy* should be confirmed with the aid of a stopwatch.

4. Maintenance

Servicing at regular intervals (eg every six months) is strongly recommended. Suppliers and/or manufacturers offer various levels of maintenance contract. The value of these compared with 'in-house' servicing (if available) should be examined by an appropriately qualified independent expert before being taken up[12, 13].

5. Routine Care of Equipment

5.1 *General care.* The generator case, leads and applicators should all be kept clean, using a cloth dampened with non-abrasive antiseptic cleaning solutions.

The equipment should be kept in a warm, dry environment. If allowed to become very cold, then it should be allowed to come to room temperature before being energised to avoid problems arising from condensation.

5.2 *Visual inspection.* All applicator and mains leads, electrodes and the casing of the equipment should be checked visually on a daily basis. Any evidence of damage, cracking or poor connection with the plug should result in the equipment being sent for repair **without delay.**

6. Applicator Output Testing

As explained above it is not easy to measure the output of the generator. However, any indication that the power output as indicated on the front panel display, or by the patient response, is different from normal should result in the machine being sent for repair.

Usually a 'neon' bulb will be supplied with the equipment. This is used to indicate qualitatively that a

capacitive diathermy machine has an output. A coil and bulb are supplied to indicate that an inductive system has an actual output. These devices may be used on a regular basis or if there is doubt that the equipment is generating energy.

7. Safety Precautions for the Operator

7.1 Only equipment that is within the specifications for safety as laid down in BS5724 (Parts 1 and 2.3) should be used.

7.2 Occupational exposure to radiofrequency electromagnetic fields in the frequency range 10-400 MHz should not exceed 1 mW/cm^2 [4, 5, 6, 7].

Exposure of the operator to radio frequency fields can, and should, be minimised by observing the following precaution:

The operator should stay at least 1 metre from the applicators and leads during operation of the equipment. Short excursions to within 0.5 m of the electrodes should occur only when absolutely necessary. Extra caution should be exercised by pregnant operators[8].

8. Safety Precautions for the Patient

8.1 Exposure of the patient to radiofrequency energy should be restricted to the minimum dosage required to achieve the benefit desired.

8.2 The treatment should be terminated if the patient shows any signs of distress, such as pain or any uncomfortable sensation which could be due either to the treatment or to poor positioning of the patient.

8.3 The area being treated should be kept dry at all times to avoid scalding.

8.4 Records should be kept for each patient treatment episode. These should include notes on the power settings, irradiation time, method of coupling (including all distances), and any special features of the treatment. It should be ensured that there is normal thermal sensation in the area to be treated. Sufficient detail should be recorded to allow repetition of the treatment conditions.

8.5 There is less risk of injury to the patient and operator if no conductive patient couches are used as these can 'distort' the field and increase the risk of rf burns occurring during treatment.

8.6 *Contra-indications and special precautions*[6, 11]

Burns and scalds. Subcutaneous fat is heated more easily than muscle tissue during shortwave therapy using capacitor type applicators. Magnetic field applicators are thus to be preferred in obese patients. The skin should be kept dry to avoid scalds from excessive temperature rise occurring in the perspiration.

Teratogenic effects. Maternal hyperthermia may give rise to abnormal fetal development. Consequently continuous shortwave exposure during pregnancy in cases in which the lower abdominal and pelvic regions may become exposed are to be avoided.

Metallic implants. Metal intensifies the electromagnetic fields, potentially leading to hazardous temperature rise. Patients having metallic implants, whether or not these are embedded in plastic materials, in the region requiring treatment should thus not receive shortwave therapy. Similarly metal objects such as jewellery should be removed from the area of treatment. Very small metal fillings in teeth are not significant.

Cardiac pacemakers. Strong electromagnetic fields can affect the performance of a pacemaker, especially if of the 'demand' type. The risk is greatest if the thorax is being treated. It is desirable to switch the pacemaker to a constant mode if one is available, and to treat only the extremities[9].

Impaired sensation. Unless there is normal thermal sensation in the area to be treated this form of therapy should be used with great care.

Evidence of cancer. This should be a contra-indication unless the treatment is for the tumour itself, as part of the cancer therapy.

Open wounds, haemorrhage, ischaemic tissue, or acute infection in the treatment site should be treated with extreme caution.

8.7 In order to avoid interference to other equipment, such as low frequency stimulators, lasers, etc, the shortwave diathermy equipment should be used at a distance such that the leads and applicators are at least 3 m, and preferably 5 m from other equipment. Precise guidance is difficult as it depends upon local arrangements and the types of equipment in use. This may cause problems in some departments and if this distance cannot be obtained then the equipment should be used at a different time.

9. Training of Personnel

Operators applying shortwave therapy equipment to patients should hold an appropriate professional qualification and have completed a course in shortwave therapy which should include instruction in the basic physics and biological effects of shortwave radiation, instrumentation, indications and contra-indications, dosages and applications. It is recommended that short revision courses be attended at least once every five years, and that all physiotherapists should keep up to date by reading appropriate professional journals.

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