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A preliminary investigation of temperature distribution in the prostatic urethra during Thermex II thermotherapy

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Abstract In a random group of five patients undergoing thermotherapy with Thermex II (Direx Systems), the temperature in the region of the external sphincter was measured using a modified Thermex catheter. In all five patients the measured temperature exceeded 44.5°C for more than half the duration of treatment. Further temperature mapping studies and studies on the assessment of sphincter function after Thermex II thermotherapy are in progress.

Key words Benign prostatic hyperplasia · External sphincter · Prostatic urethra · Radiofrequency current · Thermex II · Thermocouples

In recent years there has been increasing interest in hyperthermia and thermotherapy of the prostate for benign prostatic hyperplasia. Heat energy is delivered to the obstructing prostatic tissue with the primary aim of achieving necrosis. The various methods of energising the prostate include microwaves, radiofrequency current and focussed ultrasound waves.

Thermex II is a radiofrequency system for thermotherapy of the prostate. The heat energy is delivered to the prostate through a specially designed 16F Foley catheter. Two thermocouples and a helical electrode are mounted distal to the balloon of the catheter. During the treatment the temperature beneath the heating electrode in the prostatic urethra is monitored continuously. The maximum temperature that can be achieved is 48°C. We present here our preliminary observations on temperature distribution in the prostatic urethra using a modified catheter in five patients.

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Materials and methods

Thermex II allows heat delivery and temperature measurement along two channels. For the purpose of this investigation the two thermocouples from one catheter were detached and translocated 1 cm distal to the margin of the conducting electrode in another catheter (Fig. 1). This modified catheter with four thermocouples was used in the standard manner to deliver thermotherapy. The electrode of the catheter from which thermocouples were removed was connected to a dummy load. In this way two continuous temperature charts were obtained for each patient. These charts displayed the temperature beneath the electrode and the temperature 1 cm distal to the margin of the electrode. In all five patients the temperature at the heating electrode was set to the maximum, i.e. 48°C.

Results

The temperature measured in the distal thermoprobes in all five patients ranged from 43°C to 45.5°C. The average difference in temperature between proximal and distal thermoprobes was 3°C. For more than half the treatment duration, the temperature in the distal thermoprobes remained above 44.5°C. There was a linear correlation between the two temperature charts.

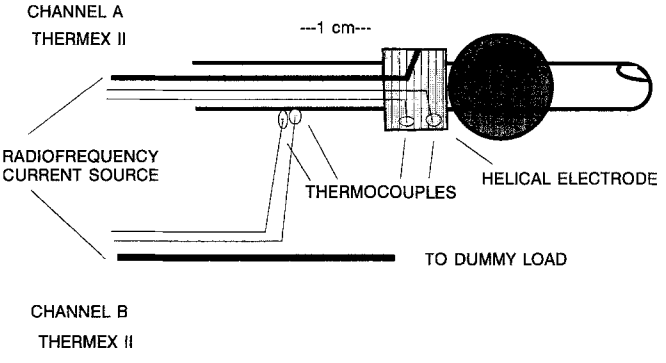

Fig. 1 Diagram to demonstrate the modified thermex catheter

Discussion

Microwave applicators for thermotherapy of the prostate have been well studied in animals, muscle equivalent phantoms and human subjects to determine the dynamics of heat production, heat loss and isothermal contours [1–3]. It is claimed that simultaneous cooling of the urethra not only reduces the perception of pain during thermotherapy but also prevents necrosis of urethral mucosa [3]. In contrast, Thermex II uses radiofrequency current to heat the prostate to 48 °C; there is no cooling mechanism in this system. We have treated more than 250 patients with Thermex II, and in our experience the patient acceptance at 48 °C in the absence of a cooling mechanism has been excellent. In only 3 patients was the treatment discontinued because of significant pain.

The isothermal contours obtained with microwaves may not necessarily apply to a radiofrequency system of thermotherapy, because of the different physical principles involved and because there is no cooling mechanism. There have been few temperature mapping studies with Thermex II. VandenBossche et al. [4] measured interstitial temperature of the prostate during Thermex II thermotherapy and found temperature of 42 °C at a distance of 22 mm from the urethra, but the maximum temperature used in their study was only 44.5 °C. Moreover, the longitudinal temperature along the prostatic urethra, especially in the sphincteric region, was not measured in that study. In our study we found that the temperature 1 cm distal to the electrode was 44.5 °C and above in all five patients studied. There is evidence of tissue necrosis at 44.5 °C in the human prostate with Thermex II [4]. A point 1 cm distal to the electrode would correspond to the external sphincter muscle in a patient with a prostate of 3 cm in length.

We have no evidence of sphincteric damage in our patients as judged by symptoms. It may be that either the external sphincter is not as thermosensitive as prostatic tissue or that some damage is caused to the sphincter muscle but remains subclinical. It is no doubt important to measure the length of prostatic urethra before thermotherapy treatment. We are presently studying urethral pressure profiles before and after thermotherapy to determine the effect of this treatment on sphincteric function. We recommend further temperature mapping studies with Thermex II to define the safety of this treatment. We would also suggest that patients with a prostatic length from bladder neck to verumontanum of less than 3 cm should not be treated with Thermex II at 48 °C until the results of the further studies on sphincter function are known.

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