6 The Role of Transrectal Ultrasound in Epidemiological Studies of Benign Prostatic Hyperplasia

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Introduction

Ultrasonography is now an established method of investigation in many areas of medicine. Although Walter and Reid attempted prostatic ultrasound as early as 1955, it was not until 1968 that the first clinically useful transrectal scans were reported (Watanabe et al. 1968). These investigators used a probe mounted on a specially designed chair which recorded serial static scans which were later analysed. Although this group subsequently reported a high acceptance rate in a series of 3000 Japanese men (Watanabe et al. 1980), there was considerable scepticism among urologists regarding patient tolerance. Technological advances, including real-time scanning, high-frequency transducers and the development of hand-help multiplanar probes, have enabled transrectal ultrasound (TRUS) to become acceptable to both patients and clinicians alike.

Technical Principles

Multiple high-frequency sound waves emitted from a transducer reflect off tissue interfaces in proportion to the density of that tissue. Reflection occurs at the boundary between materials of different impedance. Energy is also absorbed by the target tissue, but the effect of this tissue injury is clinically negligible. The frequency of ultrasound is, by definition, greater than that of audible sound, i.e. 20,000 cycles per second (20 KHz), and for medical purposes frequencies in the range of 1–10 MHz are used. Early transrectal scanners used a frequency of 3.5 MHz and have now been superseded by 7.0-MHz transducers which achieve greater resolution particularly of the peripheral zones of the gland. More recent developments include the addition of variable frequency probes with a range of 3–7 MHz. The newer transrectal probes enable one visualize the gland in coronal, sagittal or oblique planes. Experienced observers may find the sagittal view more useful with particular regard to the seminal vesicles and apex of the prostate (Lee et al. 1989a). With the multiplanar probe the operator can readily compare any area of the gland in different planes. Real-time imaging pro-
vides constant scanning and updating, and thus TRUS is also used as a
dynamic investigation in other areas of urology (Porena et al. 1987). TRUS
can be stored photographically or on video.

**Prostate Anatomy and Application to TRUS**

A detailed knowledge of the anatomy of the prostate is necessary to ade­quate­ly apply and interpret prostatic TRUS. The prostate gland is approx­imately the size of a chestnut and weighs 20 ± 5 g in the normal man,
based on autopsy data (Berry et al. 1984). The ejaculatory ducts enter the
urethra at a raised crest known as the verumontanum, and here the normal
urethra angulates 30°. The urethra can sometimes be seen traversing the
gland in the midline as a hyperechoic line (Fig. 6.1) due to echogenic
deposits in periurethral glands. The seminal vesicles are lobulated sacs
applied to the posterior aspect of the bladder and prostate. Each vesicle
joins the ampulla of the ipsilateral vas deferens to form the ejaculatory duct
which then enters the prostate. Some standard anatomy textbooks describe
the prostate as a bilateral structure (Last 1984). McNeal introduced the
concept of zonal anatomy of the prostate in 1968, and histological and
ultrasonic studies clearly support this (Lee et al. 1989a). The prostate can
thus be divided into three glandular zones and an anterior fibromuscular
stroma. Furthermore each of these areas is associated with different clinical
conditions. Figure 6.2 illustrates the zonal anatomy of the normal prostate.

![Fig. 6.1. Hyperechoic deposits highlighting the course of the urethra through the prostate. Note the 30° angulation that occurs at the verumontanum (sagittal scan)](image)