Sonablate®-500: transrectal high-intensity focused ultrasound for the treatment of prostate cancer

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Prostate cancer (PCa) is the most common cancer in men and the second leading cause of death from malignancy in the UK (1). The number of men diagnosed with PCa is increasing, due in part to an increased willingness of men to visit their family doctors with lower urinary tract symptoms, and also a willingness of physicians to test for it. As the demographic of men diagnosed with PCa becomes younger and better informed, so the demand for a less-invasive alternative to standard therapies becomes greater. The Sonablate®-500 is one of only two high-intensity focused ultrasound (HIFU) devices commercially available to treat PCa. HIFU is an attractive treatment option as it is the only form of therapy that neither involves direct instrumentation of the prostate nor ionizing radiation. This article describes the unique features of both the Sonablate®-500 system hardware and software, and the outcome data from this device in the context of current standard therapies. Finally, a view into the future attempts to outline where this technology is heading and how a paradigm shift in the way that PCa is considered may make HIFU even more relevant.

Prostate cancer (PCa) is the most common cancer in men and the second leading cause of death from malignancy in the UK (1). The mainstay of treatment remains radical surgery or radiation therapy; however, there are several minimally invasive treatments now under evaluation that may prove to be of equivalent oncological effectiveness in the long term (2). The most common radical therapy – surgical excision of the prostate – has been shown to have a modest impact on disease-specific survival in men with cancer confined to the prostate (3). Over a 10 year period, surgery offered a 5% increase in survival over observation alone (decreasing the disease specific mortality from 14 to 9%). Consider also that the side effects of the most common radical treatments are high – they include amongst others deterioration in urinary, sexual and bowel function (4,5). The profile and probability of these harmful outcomes depend to a large extent on the type of radical treatment, but all occur as a consequence of damaging tissue or structures that exist outside the prostate gland – the external sphincter, the neurovascular bundles and the rectal mucosa, respectively. Refinements in the traditional radical therapies (conformal or intensity modulated radiation therapy on the one hand vs laparoscopic or robotic radical prostatectomy on the other) have had little impact on the key treatment related morbidities (6,7).

The desirable attributes for a new technology in this field have been outlined previously (BOX 1) (8). What is required is a truly conformal, noninvasive means of performing radical treatment for PCa; reducing the side-effect profile while maintaining oncological efficacy. Transrectal high-intensity focused ultrasound (HIFU) has the potential to meet these requirements (9). HIFU relies on the physical properties of ultrasound within tissues. For therapeutic purposes ultrasound energy is focused by either an acoustic lens, bowl-shaped transducer...
or electronic phased array. As ultrasound propagates through tissue, zones of high and low pressure are created. When the energy density (in W/cm²) at the focus is sufficiently high (during the high pressure phase), tissue damage (protein denaturation) may occur as a result of thermal coagulation necrosis, whereas acoustic cavitation may occur in the pressure nadirs. Tissue water boiling may occur as a result of both the heating and cavitation effects [10]. As shown in FIGURE 1, the volume of a HIFU generated lesion at the focal point is small (typically 10–12 mm long by 3 mm wide, in a cigar shape orientated along the long axis of the beam). To ablate a continuous volume of tissue, individual HIFU lesions are placed overlapping next to each other in order to provide a continuous zone of necrosis. HIFU has been used on an experimental and clinical basis as noninvasive therapy for clinically localized PCa since the 1990s [9].

Overview of the market
The market for devices used in the treatment of organ-confined PCa is expanding. The number of men diagnosed with PCa is increasing, due in part to an increased willingness of men to visit their family doctors with lower urinary tract symptoms, and also a willingness of physicians to test for it [11]. In 2005, approximately 232,000 new cases of PCa were diagnosed in the USA and approximately 30,000 deaths from PCa occurred [12]. It is estimated that the lifetime risk for a man diagnosed with PCa is approximately 40%, and this realization has led to a great increase in the use of screening tests. In the state of Ontario, Canada the use of prostate specific antigen (PSA) testing has increased by 388% between 1996 and 2000, and in some American states over 40% of men over the age of 40 now undergo PSA screening [13]. Despite there being concerns over the use of PSA as a screening tool, it is a fact that as men become more informed, the detection rates of small, early-stage PCa will continue to rise. That having been said, there is now a movement by some oncologists and urologists not to immediately treat all early-stage PCa, but rather place these patients under ‘active surveillance’ until there is definite evidence of disease progression [14].

How the device works
The Sonablate®-500 (SB-500; Focus Surgery, Inc., IN, USA) ablates the prostate via a probe inserted into the rectum while the patient is anaesthetized. The probe contains elements that both image and deliver HIFU treatment pulses through the acoustic window opening in the probe tip.

Hardware
The SB-500 system as shown in FIGURE 2A consists of a console, printer, flat screen monitor and a transrectal probe incorporating two transducers of different focal lengths. Main accessories include an articulated probe arm and a chiller unit.

The mobile operator’s console consists of a main unit housing the ultrasound generator, flat panel 17” Active Matrix TFT-LCD color monitor, keyboard with integral mouse buttons and trackball, and a housing for a printer.

The SB-500 probe consists of probe tip, front housing, probe body and probe cable connector (FIGURE 2B). It is made from polyurethane; is just under 60 cm in length, has a tip diameter of 3.45 cm, a neck diameter of 1.8 cm and weighs 3.2 kg. The probe tip contains two ultrasound transducers of differing focal lengths mounted back-to-back (FIGURE 2C). The transducers are made from a proprietary piezoceramic and have the capability to both image and deliver HIFU treatment pulses through the acoustic window opening in the probe tip. The transducer moves in a longitudinal direction to provide sagittal images of the prostate and oscillates in the transverse plane for transverse (sector) imaging. An elastomeric sheath (latex and latex-free versions available) surrounds the probe tip, and is secured to the probe tip via two O-rings. This allows degassed and chilled water to circulate around the transducer inside the probe tip, providing the necessary coupling of the ultrasound energy for imaging and therapy to the patient, as well as rectal wall cooling. The probe body,
connected to the tip by the front housing, contains the inline rotary motor for moving the transducers for transverse imaging, and a linear actuator for sagittal movement.

The standard probe produced by Focus Surgery incorporates transducers with focal lengths of 30 and 40 mm, and a 90° treatment window (FIGURE 2D); however, probes are now available with the longer focal length of 45 or 50 mm to accommodate larger glands.

The articulated arm is a universal probe holder that can be attached to most operating tables. It has a simple locking mechanism to tighten three integral joints and a separate ring through which the probe is inserted, allowing probe positioning flexibility. This arrangement allows treatments with the SB-500 system to be performed in any setting where an operating table is available.

The Sonachill™ device circulates degassed water through the probe to cool the rectal wall and HIFU transducer. It is connected to the back panel of the SB-500 console via a solid connector cable and to the probe with hollow connecting tubes. The solid connection provides the power supply to the Sonachill and temperature feedback to the system while the hollow tubes allow water circulation.
The three main components of the chiller are:

- Liquid-to-air active cooling unit
- Peristaltic pump
- Water reservoir

An important function of the Sonachill is to remove the closed system of any air bubbles before starting the procedure. The water reservoir has a connector on the sidewall, which is connected to a syringe. This is used to adjust the volume of the sheath by pushing water in or removing it, inflating and deflating, respectively. Fine adjustment between the transducer's focal zones and the treatment regions is achieved using this syringe.

The SB-500 records treatment images either to a digital graphic printer or to the system's hard disk. This allows the physician to record (and later review) the entire HIFU treatment.

**Patient selection & preparation**

A CE mark has been awarded for the treatment of patients with primary PCa or recurrent PCa following prior therapy. Exclusion criteria include: evidence of metastatic disease; previous rectal surgery (excluding surgery for hemorrhoids); anal stenosis; metal implants or stents in the urethra; history of prostatitis in the last 6 months; or active urinary tract infection. Relative contraindications include: bleeding disorders; extensive microcalcification within the prostate; gland calcification greater than 1 cm in diameter; gland size greater than 40 ml or an antero–posterior diameter of greater than 4.0 cm when using a probe with maximum focal length of 5 cm.

Prior to therapy, patients are prepared with two phosphate enemas to empty the rectum. They then undergo spinal/epidural or general anesthesia and are placed in the lithotomy position. Prior to treatment a suprapubic catheter (SPC) may be inserted under direct vision using a cystoscope. The anal sphincter is gently dilated and the treatment probe is introduced with a covering of ultrasound gel to couple it to the rectal mucosa and then held in position by the articulated arm attached to the theatre table. A 16ch Foley urethral catheter is inserted under sterile technique, and a 10 ml balloon can be inflated to allow accurate visualization of the bladder neck and median sagittal plane, if required.
Software
The custom SB-500 application program runs on a Windows XP™ platform. It is written in C2+ and Java, uses Snag-It software to manage treatment recording and Sonablate Information Management System (SiMS™) to manage SB-500 access control.

The SB-500 HIFU Prostate Therapy software allows ultrasonic imaging of the prostate in both transverse and sagittal planes (with 3D reconstruction), on-screen treatment planning and HIFU therapy within user-defined treatment zones. At start-up an automatic system check commences which verifies the circuits and treatment cycle properties. Simple image and therapy verification functionality tests can be performed by the user or service personnel to verify proper unit function as part of a regular maintenance schedule, or after unit transportation to a new site.

The operator interfaces with the software through multiple tabbed pages – Prepare, Image, Plan, Volume and Therapy (FIGURE 3). Axial and sagittal images are taken through the prostate using the transducer in the imaging mode. Treatment planning is carried out using proprietary software that allows the prostate to be divided into treatment regions – anterior, middle and posterior, on both right and left sides if necessary (FIGURE 4). A specific program [15] allows detection of the periprostatic vessels, thought to be related to the neurovascular bundles. This can be used should the physician wish to attempt to perform a ‘nerve-sparing’ treatment to preserve erectile function (FIGURE 5). The software directs the transducer to move automatically in the region prescribed by the physician during the treatment plan mode so that the acoustic focus is moved sequentially through each point in the treatment plan. Each acoustic pulse ablates a volume of 3 × 3 × 10–12 mm by heating the tissue to 80–98°C almost instantaneously [16], and individual lesions overlap slightly to ‘paint out’ the entire volume, using a combination of 3 s exposures (’on’) time and 3 or 6 s pauses (’off’) time, during which real-time visualization of the gland takes place. The longer focal length probe is used to treat anterior and the mid-part of the gland, and the 3 cm probe used to treat the anterior block.

Box 2. Features unique to the Sonablate®-500.

- User directed power input
- Neurovascular bundle identification (FIGURE 5)
- 3D image reconstruction (FIGURE 6B)
- Intra procedure therapy plan modification using the Stack feature
- Reflectivity index measurement monitoring
As the software is semi-automated, however, control over the amount of energy that is administered to the prostate remains under the control of the user. A method of treatment termed ‘visually directed’ HIFU has been suggested, the early results of which show it to be potentially more efficacious than other techniques and systems currently available [17]. Visually directed HIFU takes into account both inter- and intraprostatic differences in acoustic and thermal properties, and allows the user to respond in real-time to the therapy.

Following therapy, patients may leave the hospital the same day with the SPC in place. A minimal amount of oral analgesia is usually required. Trial of voiding may be carried out using a flip-flow valve, and patients return in one or more weeks for removal of the SPC.

Features

The SB-500 has some unique features that differentiate it from other systems available. The most important feature, as discussed previously, is the ability to monitor the HIFU treatment in real time and respond to tissue changes by adjusting the input power according to the particular characteristics of the gland being treated. This and other features are listed in BOX 2. The reflectivity index measurement (RIM) is an important safety feature that analyzes the real-time B-mode image of the rectal wall immediately in front of the transducer and digitally compares it to the stored image taken prior to therapy. The RIM is a composite score that alerts the user to any differences between these two images either caused by patient movement or gland swelling. If the score is greater than a certain threshold then the device will automatically stop and alert the clinician.

Other important safety features include real-time rectal wall distance monitoring, rectal wall temperature monitoring, reverberation detection (to alert the user to the presence of trapped air bubbles), independent HIFU monitoring via watchdog timer circuitry and an emergency stop button to disable HIFU delivery at any time during the treatment.

Sonablate® Information Management System

The SiMS software provides a controlled interface to the Prostate Therapy software, and has been designed with the longer term aim of patient tracking (as part of a registry) and user training. There are three main features: login control that ensures that only those who have been accredited may use the system; data entry, which creates a database of demographic preoperative features of all patients treated; and a training module that will allow users to run through treatments in a controlled manner, either during primary training or as part of refresher courses.
Cost–effectiveness

Training, waste disposal & equipment required

The current training requirements for clinicians wishing to use the SB-500 are given in Table 1. The device has very few disposables. On top of a urological day-case suite with cystoscopy facilities, degassed water (<3 ppm oxygen) and nonsterile sheaths are all that are required.

Clinical profile & postmarketing findings

Phase I, II & III

The SB-500 has been granted CE marking in Europe and US FDA-approved clinical trials are currently on-going. The results of a multicenter Japanese trial were published in 2005 [18] and a multicenter European trial assessing the SB-500 is currently underway, which should report back in 2007. Transrectal HIFU for PCa was reviewed by the National Institute for Health and Clinical Excellence in 2005 and, following its report, was cleared for use in the UK within the National Health Service [101].

A problem facing all new technologies used to treat organ-confined PCa is the length of time required to generate outcome data. True figures regarding the disease-specific mortality following radical prostatectomy have only recently become available, and these show only a modest improvement in survival at 10 years after treatment versus watchful waiting [3]. Owing to this, proxy measures of outcome must be used, with biopsy negativity and American Society for Therapeutic Radiology and Oncology (ASTRO) criteria the most common. A recent paper has shown that a low PSA nadir following treatment is strongly correlated with good outcome on subsequent post-treatment biopsy [19], and evidence of persistent enhancement on post-treatment contrast-enhanced magnetic resonance imaging also strongly predicts both failure on biopsy and subsequent PSA nadir [20].

The largest case series of patients treated with the SB-500 comes from Uchida’s group in Japan. This group have shown that they were able to achieve a biopsy negative rate of 87% 6 months after treatment in men with presumed localized PCa [21], with a PSA nadir of less than 1 ng/ml in 72% of patients treated (63 patients). At a mean of 5-years follow-up they showed a freedom from biochemical recurrence (based on ASTRO criteria) of 78% [22], in particular, patients with a pretreatment PSA of 10 ng/ml or less demonstrated 94 and 77% biochemical disease free survival at 4- and 5-years follow-up, respectively (181 patients). It is important to note that this group were not using visually directed HIFU in their series; they used predetermined power levels defined from in vitro and in vivo experimentation [22]. This series compares very favorably

<table>
<thead>
<tr>
<th>Study</th>
<th>Device</th>
<th>Treatment method</th>
<th>Patient no.</th>
<th>PSA nadir target (ng/ml)</th>
<th>% achieving</th>
<th>Mean nadir ng/ml</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chaussy and Thüroff</td>
<td>Ablatherm</td>
<td>Algorithm</td>
<td>184</td>
<td>≤0.5</td>
<td>61</td>
<td>1.65</td>
<td>[42]</td>
</tr>
<tr>
<td>Gelet et al.</td>
<td>Ablatherm</td>
<td>Algorithm</td>
<td>82</td>
<td>≤1.0</td>
<td>56</td>
<td>1.02</td>
<td>[41]</td>
</tr>
<tr>
<td>Thüroff et al.</td>
<td>Ablatherm</td>
<td>Algorithm</td>
<td>402</td>
<td>Not given</td>
<td>Not given</td>
<td>1.85</td>
<td>[43]</td>
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<tr>
<td>Blana et al.</td>
<td>Ablatherm</td>
<td>Algorithm</td>
<td>137</td>
<td>≤0.1</td>
<td>56</td>
<td>83</td>
<td>[44]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>≤0.5</td>
<td>83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uchida et al.</td>
<td>SB-500</td>
<td>Algorithm</td>
<td>63</td>
<td>≤0.2</td>
<td>32</td>
<td>1.38</td>
<td>[22]</td>
</tr>
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<td></td>
<td></td>
<td>≤1.0</td>
<td>72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illing et al.</td>
<td>SB-500</td>
<td>Visually directed</td>
<td>25</td>
<td>≤0.2</td>
<td>84</td>
<td>0.15</td>
<td>[17]</td>
</tr>
</tbody>
</table>
with a recent study by Potters and colleagues that compared seven year outcome data between cohorts undergoing radical surgery (RP) (746 patients), external beam radiotherapy (EBRT) to a minimum 70 Gy (340 patients) and low-dose rate seed brachytherapy (LDR BT) (733 patients) [23]. The oncological outcome was defined as freedom from biochemical recurrence (FBR) based on ASTRO criteria for EBRT and LDR-BT, and PSA of less than 0.2 for RP. FBR was similar in all three groups; 74, 77 and 79% at 7 years for LDR-BT, EBRT and RP, respectively.

Proponents of visually directed HIFU suggest that lower PSA nadirs may be achieved using direct visual feedback to tailor treatment to the individual [17]. Comparison of mean nadirs achieved between visually directed HIFU and other HIFU devices (or indeed with the SB-500, when using the pre-set energies) is given in Table 2. An example of images taken before and after visually directed HIFU are given in Figure 7.

The adverse event rate for this procedure has been described by Uchida and colleagues [22]. Having treated 181 patients, they found a prepsychic stricture rate of 22%, epididymitis occurring in 6%, a rectourethral fistula in 0.5%, erectile dysfunction in previously potent men of 20% and no stress incontinence lasting more than 1 month. In the cases of prepsychic strictures all were managed with periodic urethral dilatation. The experience of UK clinicians using visually directed HIFU is similar – at a recent meeting of European users of the SB-500, a cohort of 81 patients treated in London was described in which the stricture rate was 15%, infection rate 6% and erectile dysfunction in previously potent men of 25%. In this group, grade 1 stress incontinence persisted more than 3 months in 4% of those treated [LESLIE TA, PERS. COMM.]. Overall, these figures are very acceptable compared with other radical therapies such as radical prostatectomy, which even in the hands of high volume surgeons may have a long-term incontinence rate (requiring surgical intervention) of almost 7% [24]. It has been the experience of those using the Ablatherm® device that the postprocedure stricture rate is reduced by the administration of a preprocedural transurethral resection of the prostate (TURP). In one study, additional de-obstruction procedures were required in 27% of those undergoing HIFU alone and in 8% of those with combined resection [25]. This must therefore be considered by the physician – should 100% of patients undergo the risks associated with transurethral resection, rather than only those who require intervention subsequently?

In an attempt to further reduce the impotence rates, the ‘neurovascular bundle’ detection system has been developed (see Patient selection & preparation). This relies upon the assumption that neurological mechanism for erection is related anatomically to the vascular bundles lying antero–lateral to the prostate capsule. While this is possible, there are no clinical studies yet available that demonstrate this association. A further caveat remains that by deliberately undertreating portions of the gland, the risk of residual disease is greater.

Alternative devices
See Table 3.

Conclusion

Viewpoint
It has been shown that HIFU using the SB-500 has many of the desirable attributes of a new ablative technology (Box 1), incorporated into a highly mobile and expandable treatment platform. It may be administered under local/regional anesthesia; however, the trend, certainly in Europe, is to use general anesthesia. Real-time monitoring of the treatment may be performed, but more importantly, the information gained from the monitoring may be used by the clinician to guide therapy in a ‘visually directed’ manner. This is the key feature that differentiates it from other transrectal HIFU devices currently available. So far the oncological data looks promising – although long-term results are not available, 5-year data is now emerging that appears comparable with all of the current mainstream modalities for the treatment of organ-confined PCa. The side-effect profile also appears very promising – reported incontinence, erectile dysfunction and infection rates all appear better than current modalities. The urethral stricture rate is high and currently under evaluation [LESLIE TA, PERS. COMM.].
Further attractions of HIFU are that it is repeatable, of relatively low running cost and does not provide a therapeutic impasse – surgery and radiotherapy, as well as further HIFU sessions, are possible following initial treatment failure [22].

One of the concerns regarding population screening for PCa in the healthy population is that the available therapies for it may cause significant harm to the patient. This goes against one of the five key principles of an effective screening program – that the benefits of treatment for a condition must outweigh...
the risks [26]. Not taking into account the problematic nature of
the PSA test itself, having a potential therapy that can offer
comparable oncological efficacy with a lower adverse event rate
may encourage more men to come forward for screening, thus
increasing the diagnostic pick-up.

Expert commentary
The trend in all surgical disciplines is for less-invasive treat-
ments. Open surgery has given way to laparoscopic procedures
in many areas, and needle-ablative therapies (such as cryother-
apy and radiofrequency ablation) are gaining ground [27,28].
The next conceptual change is the ability to treat entirely
noninvasively – and in HIFU this is realized.

The key difference between the SB-500 and other current
transrectal HIFU technology is the ability for the user to
tailor treatment to the individual. Other systems may have
real-time imaging, however, if the treatment delivered is
derived from a preset algorithm, any input from the user over
defining the margins of the prostate is obviated. Clinicians
familiar with transrectal ultrasound will acknowledge that
the characteristics of prostate glands differ between patients.
Even men who have had no prior therapy may have glands of
different density and with different patterns of micro- or
macrocalcification. Just as the amount of pressure that is
required to exert on the scalpel is based upon the real-time
characteristics of the tissue it is passing through, so is the
amount of energy required to cause ablation within the pros-
tate gland. It is hoped that the early outcomes based on PSA
nadir [17] can be translated into medium-term biochemical
and histological freedom from disease, and ultimately
survival benefit.

Future developments
There is a great deal of work underway in the field of focused
ultrasound, both clinically and in the laboratory. In 2006, inves-
tigation into aspects of HIFU have generated over 1 million
pounds in UK government research grants from the Engineering
and Physical Sciences Research Council alone [102,103].

Considerable work has already taken place into the develop-
ment of probes for other HIFU applications and phased array
transducer technology [29]. Most clinical devices in use have
either single-element therapeutic transducers or multielement
arrays that act as a single element. Transducers with annular
arrays, allowing the focal point to be electronically moved
towards and away from the transducer face, and 2D arrays
that allow horizontal, lateral and vertical translation of the
focal point without moving the transducer itself, have already
been constructed for experimental purposes (FIGURE 8). Cou-
pled with this, speckle tracking technology is in development,
which may allow software to follow the movement of a target
over time such as through the respiratory cycle, or if the target
organ changes shape during the procedure due to edema [30].
This paves the way for a system that does not have to physi-
cally move during the treatment, but also accounts for any
intraoperative changes automatically.

Visual changes are not the only method of real-time feed-
back. Tissue elastography [31] and ultrasound thermometry [32]
are in development, but remain experimental; magnetic reso-
nance imaging (MRI) [33] may accurately detect temperature
changes, however, MRI devices are costly, do not provide feed-
back as instantaneously as B-mode ultrasound and have not
been used clinically in the setting of transrectal prostate HIFU.

Novel methods enhancing the effect of focused ultrasound
are in development. Injected microbubbles have not only been
used as a contrast agent, but also to enhance ablation [34] and
aid the delivery of genes and chemotherapy [35]. Added to this
are the potential synergistic effects of combining focused ultra-
sound with ionizing radiation, which have yet to be explored,
but which may have a role in the treatment of high-risk or
locally advanced disease.

Lastly, interest in the effect of ablative technologies on immune
upregulation [36], potentially provoke the body into producing an
innate antitumor response following treatment, is growing.

Five-year view
In 5-years’ time the field of PCa therapy may have altered radi-
cally. Not only will new drugs and devices have emerged (possibly
based on those areas outlined above), but there may also have
been a paradigm shift in the way that early disease is viewed.
Whatever the modality, the current treatment for organ-confined
disease is ‘radical’ – the whole gland is treated, as well as the PCa
within it. The reasons for this are straightforward; PCa may be
multifocal in nature, detection of small foci of disease has been
difficult and the tools to perform such precise treatment were
missing. Already this picture has changed – a range of new modal-
ities for targeted treatment have emerged, of which HIFU is argu-
ably the most promising [37], and improvements in imaging and
biopsy technique allow greater levels of confidence that all signifi-
cant foci of disease have been accounted for [38]. There is no doubt
that PCa can be multifocal, but if the targeting and treatment

Figure 8. (A) Annular array electrode laser-scribed on convex side. (B)
Annular array installed in Sonablate®-500 HIFU probe. (C) Cylindrical 2D array
electrode laser-scribed on convex side of piezocomposite material prior to
forming, and (D) completed cylindrical HIFU array transducer assembled
from [29].

HIFU: High-intensity focused ultrasound.
methods are sufficiently accurate there is the potential for a ‘male lumpectomy’, much in the same way as radical mastectomy has been superseded by lumpectomy for early-stage breast cancer in women [39]. This has the potential to greatly reduce the associated side effects of radical treatment for PCa, and indeed trials are currently underway to assess the feasibility of this approach.

Information resources

- The International Symposium for Therapeutic Ultrasound
  www.istus.org
- Cancer Research UK
  www.cancerhelp.org.uk
- Cancer Research UK
  www.istus.org
- The Prostate Cancer Charity
  www.prostate-cancer.org.uk
- Focus Surgery
  www.focus-surgery.com
- UK HIFU
  www.ukhifu.co.uk

Conflict of interest

Rowland Illing is supported by a grant from Misonix. Mark Emberton has acted as a paid consultant to Misonix. Misonix is the European manufacturer and distributor of the Sonablate device.

Key issues

- High-intensity focused ultrasound (HIFU) is a noninvasive therapy that has the potential to treat prostate cancer in a radical manner.
- The Sonablate®-500 is the only transrectal device currently available that uses intraoperative feedback to guide treatment and to tailor it to the individual.
- Early data from this technique look promising with medium-term outcome data from less tailored treatments looking similar to results from standard therapies.
- The published side-effect profile following Sonablate-HIFU is better than current standard therapies.
- There is a great deal of interest in this field and developments are underway to refine both the conduct of therapy and the devices in use.
- There is potentially a paradigm shift in the way early-stage prostate cancer is treated – more accurate diagnosis coupled with the accuracy of HIFU could pave the way to widespread use of focal therapy for early-stage disease.

References

Papers of special note have been highlighted as:
- of interest
- of considerable interest
• An excellent overview of the principles of high-intensity focused ultrasound (HIFU) and the scope of diseases currently being treated.
• Benchmark textbook describing the physics behind therapeutic ultrasound in detail.
17 Illing RO, Leslie TA, Kennedy JE, Callery JG, Ogden CW, Emberton M. Visually directed HIFU for organ confined prostate cancer – a proposed standard for
the conduct of therapy. BJU Int. 98(6), 1187–1192 (2006).

• Details the conduct of visually directed HIFU and provides the rationale for its use.


• First paper to define the association between PSA nadir following prostate HIFU and outcome.


• Provide the largest case series of patients treated with the Sonablate®-500 (SB-500).

• Provide the largest case series of patients treated with the SB-500.


Websites

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