Ultrasound Scans - Cause for Concern

First published in Nexus magazine, vol 9, no 6, Oct-Nov 2002,

An expanded and updated version of this article is available in Sarah's book: *Gentle Birth, Gentle Mothering; The wisdom and science of gentle choices in pregnancy, birth, and parenting.* Details are available at www.sarahjbuckley.com.

When I was pregnant with my first baby in 1990, I decided against having a scan. This was a rather unusual decision, as my partner and I are both doctors and had even done pregnancy scans ourselves - rather ineptly, but sometimes usefully - while training in GP Obstetrics a few years earlier.

What influenced me the most was my feeling that I would lose something important as a mother if I allowed someone to test my baby. I knew that if a minor or uncertain problem showed up (this is not uncommon), that I would be obliged to return again and again, and that after a while, it would feel as if my baby belonged to the system, and not to me.

In the years since then I have had three more unscanned babies, and have read many articles and research papers about ultrasound. Nothing I have read has made me reconsider my decision. Although ultrasound may sometimes be useful when specific problems are suspected, my conclusion is that it is at best ineffective and at worse dangerous when used as a 'screening tool' for every pregnant woman and her baby.

Ultrasound past and present

Ultrasound was developed during WWII to detect enemy submarines, and was subsequently used in the steel industry. In July 1955 Glasgow surgeon Ian Donald borrowed an industrial machine and, using beefsteaks as controls, began to experiment with abdominal tumours which he had removed from his patients. He discovered that different tissues gave different patterns of 'echo', leading him to realise that ultrasound offered a revolutionary way to look into the previously mysterious world of the growing baby (Wagner 1995).

This new technology spread rapidly into clinical obstetrics. Commercial machines became available in 1963 (De Crespigny 1996) and by the late 1970's ultrasound had become a routine part of obstetric care (Oakley 1986). Today, ultrasound is seen as safe and effective and scanning has become a rite of passage for pregnant women in developed countries. Here in Australia, it is estimated that 99% of babies are scanned at least once in pregnancy - mostly as a routine prenatal ultrasound (RPU) at 4 to 5 months.

However, there is growing concern as to its safety and usefulness. UK consumer activist Beverley Beech has called RPU "the biggest uncontrolled experiment in history" (Beech 1993), and the Cochrane Collaborative Database - the peak scientific authority in medicine-concludes that "…no clear benefit in terms of a substantive outcome measure like perinatal mortality [number of babies dying around the time of birth] can yet be discerned to result from the routine use of ultrasound." (Neilson 1999).

This seems a very poor reward for the huge costs involved. In 1997-8, for example, $39 million was paid by the federal government for pregnancy scans - an enormous expense compared to $54 million for all other obstetric medicare costs. This figure does not include the additional costs paid by the woman herself.

In 1987, UK radiologist H.D.Meire, who had been performing pregnancy scans for 20 years, commented, "The casual observer might be forgiven for wondering why the medical profession is now involved in the wholesale examination of pregnant patients with machines emanating vastly different powers of energy which is not proven to be harmless to obtain information which is not proven to be of any clinical value by operators who are not certified as competent to perform the operations."(Meire 1987). The situation today is unchanged, on every count.

The 1999 Senate Committee report, 'Rocking the Cradle' recommended that the cost-benefit of routine scanning, and of current ultrasound practices, be formally assessed. Recommendations were also made to develop guidelines for the safe use of all obstetric ultrasound, as well as for the development of standards for the training of ultrasonographers (see below). So far, none of these recommendations have been implemented (Senate Committee 1999).

What is Ultrasound?

The term 'ultrasound' refers to the ultra-high frequency soundwaves used for diagnostic scanning: these waves travel at 10 to 20 million cycles per second, compared to10 to 20 thousand cycles per second for audible sound (De Crespigny 1996). Ultrasound waves are emitted by a transducer (the part of the machine that is put onto the body), and a picture of the underlying tissues is built up from the pattern of "echo" waves which return. Hard surfaces such as bone will return a stronger echo than soft tissue or fluids, giving the bony skeleton a white appearance on the screen.

Ordinary scans use pulses of ultrasound which last only a fraction of a second, with the interval between waves being used by the machine to interpret the echo that returns. In contrast, doppler techniques, which are used in specialised scans, fetal monitors and hand-held fetal stethescopes ('sonicaids') feature continuous waves, giving much higher levels of exposure than 'pulsed' ultrasound. Many women do not realise that the small machines used to listen to their baby's heartbeat are actually using doppler ultrasound, albeit with low dose parameters.

More recently, ultrasonographers have been using vaginal ultrasound, where the transducer is placed high in the vagina, much closer to the developing baby. This is used mostly in early pregnancy, when abdominal scans can give poor pictures. However, with vaginal ultrasound, there is little intervening tissue to shield the baby, who is at a vulnerable stage of development, and exposure levels will be high. Having a vaginal ultrasound is not a pleasant procedure for the woman; the term 'diagnostic rape' was coined to describe how some women experience vaginal scans.

Another recent application for ultrasound is the 'nuchal translucency test', where the thickness of the skin fold at the back of the baby's head is measured at around 3 months; a thick 'nuchal (neck) fold' makes the baby more likely, statistically, to have Downs syndrome. When the baby's risk is estimated to be over 1 in 250, a definitive test is recommended. This involves taking some of the baby's tissue by amniocentesis or chorionic villus sampling. Around 19 out of 20 babies diagnosed as 'high risk' by nuchal translucency will not turn out to be affected by Down's syndrome, and their mothers will have experienced several weeks of unnecessary anxiety. A nuchal translucency scan does not detect all babies affected by Down's syndrome.

Information gained from Ultrasound

Ultrasound is mainly used for two purposes in pregnancy - either to investigate a possible problem at any stage of pregnancy, or as a routine scan at around 18 weeks.

If there is bleeding in early pregnancy, for example, ultrasound may predict whether miscarriage is inevitable. Later in pregnancy, ultrasound can be used when a baby is not growing, or when a breech baby or twins are suspected. In these cases, the information gained from ultrasound can be very useful in decision-making for the woman and her carers. However the use of routine prenatal ultrasound (RPU) is more controversial, as this involves scanning (or 'screening') all pregnant women in the hope of improving the outcome for some mothers and babies.

The timing of routine scans (18 to 20 weeks) is chosen for pragmatic reasons. It offers a reasonably accurate due date - although dating is most accurate at the early stages of pregnancy, when babies vary the least in size - and the baby is big enough to see most of the abnormalities that are detectable on ultrasound. However, at this stage, the EDD (expected date of delivery) is only accurate to a week either side, and some studies have suggested that an early examination, or calculations based on a woman's menstrual cycle, can be as accurate as RPU. (Olsen and Clausen, 1997; Kieler et al, 1993).

And while many women are reassured by a normal scan, RPU actually detects only between 17% and 85% of the 1 in 50 babies that have major abnormalities at birth (Ewigman 1993, Luck 1992). A recent study from Brisbane showed that ultrasound at a major women's hospital missed around 40% of abnormalities, with most of these being difficult or impossible to detect (Chan 1997). Major causes of intellectual disability such as cerebral palsy and Down's syndrome are unlikely to be picked up on a routine scan, as are heart and kidney abnormalities.

When an abnormality is detected, there is a small chance that the finding is a 'false positive', where the ultrasound diagnosis is wrong. A UK survey showed that, for 1 in 200 babies aborted for major abnormalities, the diagnosis on post-mortem was less severe than predicted by ultrasound and the termination was probably unjustified. In this survey, 2.4% of the babies diagnosed with major malformations, but not aborted, had conditions that were significantly over or under-diagnosed (Brand 1994).

There are also many cases of error with more minor abnormalities, which can cause anxiety and repeated scans, and there are some conditions which have been seen to spontaneously resolve (eg see Saari-Kemppainen 1990).

As well as false positives, there are also uncertain cases, where the ultrasound findings cannot be easily interpreted, and the outcome for the baby is not known. In one study involving women at high risk, almost 10% of scans were uncertain (Sparling 1988) This can create immense anxiety for the woman and her family, and the worry may not be allayed by the birth of a normal baby. In the same study, mothers with "questionable" diagnoses still had this anxiety 3 months after the birth of their baby.

In some cases of uncertainty, the doubt can be resolved by further tests such as amniocentesis. In this situation, there may be up to two weeks wait for results, during which time a mother has to decide if she would terminate the pregnancy if an abnormality is found. Even mothers who receive reassuring news have felt that this process has interfered with their relationship with their baby (see Brookes, 1995).

As well as estimating the EDD and checking for major abnormalities, RPU can also identify a low-lying placenta (placenta praevia), and detect the presence of more than one baby at an early stage of pregnancy. However, 19 out of 20 women who have placenta praevia detected on an early scan will be needlessly worried: the placenta will effectively move up, and not cause problems at the birth. Furthermore detection of placenta praevia by RPU has not been found to be safer than detection in labour (Saari-Kemppainen, 1990). No improvement in outcome has been shown for multiple pregnancies either; the vast majority of these will be detected before labour, even without RPU (MIDIRS 1995).

The American College of Obstetricians, in their guidelines on routine ultrasound in low-risk pregnancy, conclude "In a population of women with low-risk pregnancies, neither a reduction in perinatal morbidity [harm to babies around the time of birth] and mortality nor a lower rate of unnecessary interventions can be expected from routine diagnostic ultrasound.

Thus ultrasound should be performed for specific indications in low-risk pregnancy"(ACOG 1997).

Biological effects of Ultrasound

Ultrasound waves are known to affect tissues in two main ways. Firstly, the sonar beam causes heating of the highlighted area by about 1 degree celsius. This is presumed to be non-significant, based on whole-body heating in pregnancy, which seems to be safe up to 2.5 degrees celsius (Am Inst of Ultrasound Medicine Bioeffects Report 1988).

The second recognised effect is cavitation, where the small pockets of gas which exist within mammalian tissue vibrate and then collapse. In this situation "…temperatures of many thousands of degrees celsius in the gas create a wide range of chemical products, some of which are potentially toxic. These violent processes may be produced by micro-second pulses of the kind which are used in medical diagnosis…." (Am Inst of Ultrasound Medicine Bioeffects Report 1988). The significance of cavitation effects in human tissue is unknown.

A number of studies have suggested that these effects are of real concern in living tissues. The first study suggesting problems was a study on cells grown in the lab. Cell abnormalities caused by exposure to ultrasound were seen to persist for several generations (Liebeskind 1979). Another study showed that, in newborn rats (who are at a similar stage of brain development to humans at 4 to 5 months in utero), ultrasound can damage the myelin that covers nerves (Ellisman 1987), indicating that the nervous system may be particularly susceptible to damage from this technology.

A 1999 animal study by Brennan and colleagues, reported in New Scientist (June 12 1999), showed that exposing mice to dosages typical of obstetric ultrasound caused a 22% reduction in the rate of cell division, and a doubling of the rate of aptosis, or programmed cell death, in the cells of the small intestine.

Mole (1986) comments "If exposure to ultrasound… causes death of cells, then the practice of ultrasonic imaging at 16 to 18 weeks will cause loss of neurones [brain cells] with little prospect of replacement of lost cells…The vulnerability is not for malformation but for maldevelopment leading to mental impairment caused by overall reduction in the number of functionning neurones in the future cerebral hemispheres."

Studies on humans exposed to ultrasound have shown that possible adverse effects include premature ovulation (Testart 1982), preterm labour or miscarriage (Lorenz, 1990; Saari-Kemppainen 1990), low birth weight (Newnham, 1993, Geerts 1996), poorer condition at birth (Thacker 1985; Newnham, 1991), perinatal death (Davies 1992) dyslexia (Stark 1984), delayed speech development (Campbell, 1993) and less right-handedness (Salvesen 1993: Kieler 1998a, Salvesen 1999, *Kieler 2001*). Non right-handedness is, in

other circumstances, seen as a marker of damage to the developing brain (see Odent 1998, Keiler 2001). One Australian study showed that babies exposed to 5 or more doppler ultrasounds were 30% more likely to develop intrauterine growth retardation (IUGR) - a condition that ultrasound is often used to detect (Newnham, 1993) .

Two long-term randomised controlled trials, comparing exposed and unexposed children's development at 8 to 9 years old, found no measurable effect from ultrasound (Salvesen 1992, Kieler 1998b). However, as the authors note, intensities used today are many times higher than in 1979 to 1981. Further, in the major branch of one trial, scanning time was only three minutes (Salvensen 1993). More studies are obviously needed in this area, particularly in the areas of Doppler and vaginal ultrasound, where exposure levels are much higher.

A further problem with studying ultrasound's effect is the huge range of output, or dose, possible from a single machine. Modern machines can give comparable ultrasound pictures using a lower, or a 5000 times higher dose (Meire 1987), and there are no standards to ensure that the lowest dose is used. Because of the complexity of machines, it is difficult to even quantify the dose given in each examination (Taylor 1990). In Australia training is voluntary, even for obstetricians, and the skill and experience of operators varies widely.

A recent summary of the safety of ultrasound in human studies, published in May 2002 in the prestigious US journal Epidemiology concluded "….there may be a relation between prenatal ultrasound exposure and adverse outcome. Some of the reported effects include growth restriction, delayed speech, dyslexia, and non-right-handedness associated with ultrasound exposure. Continued research is needed to evaluate the potential adverse effects of ultrasound exposure during pregnancy. These studies should measure the acoustic output, exposure time, number of exposures per subject, and the timing during the pregnancy when exposure(s) occurred" (Marinac-Dabic 2002).

The UK consumer organisation AIMS has produced a booklet *Ultrasound Unsound?* , originally published in 1993 and recently updated. This very comprehensive publication, which I highly recommend, includes a form that pregnant women undergoing ultrasound can ask their carers to fill out. You can make your own form based on the information as below, or obtain the booklet from www.birthinternational.com.au

My Baby's Ultrasound Exposure Record

- The following procedure requires the use of ultrasound……..
- This is necessary to obtain the following information ……
- To my knowledge, there is no current alternative method available to obtain this information that carries less risk to ……. …….(mother's name)

  Signature (doctor or midwife)…… Date ……..

The ultrasonographer is asked to specify

- Manufacturer and model of ultrasound equipment……
- Date of last calibration……..
- Type or combination of types of ultrasound used……..
- Intensity of exposure (W/cm sq or mW/cm sq)
- Time commenced……..Time Completed…….
- Duration of exposure…….
- Name of hospital or clinic……..

  Carried out by……

  Qualifications…… Position…….

  Signature……. Date…….

Women's experiences of Ultrasound

Women have not been consulted at any stage in the development of this technology, and their experiences and wishes are presumed to coincide with, or be less important than, the medical information that ultrasound provides. For example, supporters of RPU presume that early diagnosis and/or termination is beneficial to the affected woman and her family. However the discovery of a major abnormality on RPU can lead to very difficult decision-making.

Some women who agree to have an ultrasound are unaware that they may get information about their baby that they do not want, as they would not contemplate a termination. Other women can feel pressured to have a termination, or at the least feel some emotional distancing from their "abnormal" baby (Brookes, 1995). Furthermore, there is no evidence that women who have chosen termination are, in the long term, psychologically better off than women whose babies have died at birth; in fact, there are suggestions that the opposite may be true in some cases (Watkins 1989). And when termination has been chosen, women are unlikely to share their story with others and can experience considerable guilt and pain from the knowledge that they themselves chose the loss (MIDIRS 1996).

When minor abnormalities are found - which may or may not be present at birth, as discussed above - women can feel that some of the pleasure has been taken away from their pregnancy.

Women's experiences with ultrasound and other tests used for prenatal diagnosis (eg amniocentesis) are thoughtfully presented in the book 'The Tentative Pregnancy' by Barbara Katz Rothman. The author documents the heartache that women can go through when a difficult diagnosis is made-for some women, this pain can take years to resolve.She suggests that the large numbers of screening tests currently being offered to check for abnormalities may make every woman feel that her pregnancy is 'tentative' until she receives reassuring results.

To my mind, ultrasound also represents yet another way in which the deep internal knowledge that a mother has of her body and her baby is made secondary to technological information that comes from an 'expert' using a machine. Thus the 'cult of the expert' is imprinted from the earliest weeks of life.

Furthermore by treating the baby as a separate being, ultrasound artificially splits mother from baby well before this is a physiological or psychic reality. This further emphasises our cultures favouring of individualism over mutuality and sets the scene for possible - but to my mind artificial - conflicts of interest between mother and baby in pregnancy, birth and parenting.

Conclusions and recommendations

I would urge all pregnant women to think deeply before they choose to have a routine ultrasound. It is not compulsory, despite what some doctors have said, and the risks, benefits and implications of scanning need to be considered for each mother and baby, according to their specific situation.

If you choose to have a scan, be clear about the information that you do and do not want to be told. Have your scan done by an operator with a high level of skill and experience (usually this means performing at least 750 scans per year) and say that you want the shortest scan possible. Ask them to fill out the form, or give you the information, as above, and to sign it.

If an abnormality is found, ask for counselling and a second opinion as soon as practical. And remember that it's your baby, your body and your choice.

References

American College of Obstetricians and Gynecologists (ACOG) Routine Ultrasound in Low-Risk Pregnancy. In:ACOG Practice Patterns - Evidence-Based Guidelines for Clinical Issues in Obstetrics and Gynecology. Number 5 August 1997

Association for Improvements in the Maternity services (AIMS) - AIMS UK. Ultrasound Unsound? AIMS Journal vol 5 no 1, spring 1993. The updated version is available from www.birthinternational.com.au

American Institute of Ultrasound Medicine Bioeffects Report 1988. J Ultrasound Medicine 7S1-S38. Sept 1988

Beech BL. Ultrasound - unsound? Talk at Mercy Hospital, Melbourne, April 1993

Brand IR, Kaminopetros P, Cave M et al. Specificity of antenatal ultrasound in the Yorkshire region: a prospective study of 2261 ultrasound detected anomalies. Br J Obstet Gynaecol 1994. Vol 101, no5. pp 392-397

Brookes, A. Women's experience of routine prenatal ultrasound. Healthsharing Women: The newsletter of Healthsharing Women's Health Resource Service. Vol 5, no's 3 & 4. Dec 1994 - March 1995.

Campbell JD et al Case-control study of prenatal ultrasonography in children with delayed speech. Can Med Ass J 1993 vol 149 no 10 pp1435-1440

Chan FY. Limitations of Ultrasound. Paper presented at Perinatal Society of Australia and New Zealand 1st Annual Congress, Freemantle 1997

Davies J et al. Randomised controlled trial of doppler ultrasound screening of placental perfusion in pregnancy. Lancet 1992;340:1299-1303

De Crespigny L, Dredge R. *Which Tests for my Unborn Baby, Revised Edition.* Oxford University Press, Melbourne 1996.

Ellisman MH, Palmer DE, Andre MP. Diagnostic levels of ultrasound may disrupt myelination. Experimental Neurology 1987 vol 98 no 1 pp78-92

Ewigman BG, Crane JP, Frigoletto FD et al. Effect of prenatal ultrasound screening on perinatal outcome.RADIUS study group. N Engl J Med . 1993 vol 329, no 12, pp821-7

Geerts JGM, Brand E, Theron B. *Routine obstetric ultrasound in South Africa: cost and effect on perinatal outcome - a prospective randomised controlled trial.* Br J Obstet Gynaecol 1996. Vol 103. pp501-507

Kieler H, Axelsson O, Nilsson S, Waldenstrom U. Comparison of ultrasonic measurement of biparietal diameter and last menstrual period as a predictor of day of delivery in women with regular 28 day cycles. Acta-Obstet-Gynecol-Scand, 1993 vol 75 no 5 pp 347-9

Kieler H, Axelsson O, Haguland B, et al. Routine ultrasound screening in pregnancy and the children's subsequent handedness. Early Hum Dev 1998 , vol 50 no 2, pp233-245

Kieler H, Ahlsten G, Haguland B et al. Routine ultrasound screening in pregnancy and the children's subsequent neorological development. Obstet Gynecol 1998 vol 91 5 (pt 1) pp750-6

Kieler H, Cnattingius S, Haglund B et al. Sinistrality - a side-effect of prenatal sonography: A comparative study of young men.Epidemiology 2001:12 (6):618-23

Luck CA. Value of routine ultrasound scanning at 19 weeks: a four year study of 8849 deliveries. BMJ 1992, vol 34, no 6840, pp1474-8

Liebeskind D, Bases R, Elequin F et al. Diagnostic ultrasound: effects on the DNA and growth patterns of animal cells. Radiology 1979 vol 131, no1, pp 177-184

Lorenz RP, Comstock CH, Bottoms SF, Marx SR. Randomised prospective trial comparing ultrasonography and pelvic examination for preterm labor surveillance. Am J Obstet Gynecol 1990 vol 162 no 6 pp 1603-1610

Marinac-Dabic D, Krulewitch CJ, Moore RM Jr. The safety of prenatal ultrasound exposure in human studies. Epidemiology 2002 May; 13(3 Suppl):S19-22

Meire HB. The safety of diagnostic ultrasound (commentary). Br J Obstet Gynaecol 1987 vol 94, pp1121-1122

MIDIRS. Informed Choice for professionals leaflet no 3. Ultrasound screening in the first half of pregnancy: is it useful for everyone? MIDIRS and the NHS centre for Reviews and Dissemination. 1996

Mole R. Possible hazards of imaging and Doppler ultrasound in obstetrics. Birth 1986 vol 13, pp329-37

Neilson JP.Ultrasound for fetal assessment in early pregnancy (Cochrane Review). In:The Cochrane Library, Issue 2, 2002. Oxford"Update Software

New Scientist Shadow of doubt 12 June 1999, p23

Newnham J, Evans SF, Michael CA et al. Effects of frequent ultrasound during pregnancy: a randomised controlled trial. Lancet 1993, vol 342, no 8876, pp887-91

Newnham JP et al. Doppler flow velocity wave form analysis in high risk pregnancies: a randomised controlled trial. Br J Obstet Gynaecol, 1991,vol 98 no 10, pp956-963

Oakley Ann The history of ultrasonography in obstetrics. Birth, 1986 vol 13, no 1, pp 8-13

Odent M. Where does handedness come from? Primal Health Research Quarterly 1998, vol 6 no 1.

Olsen O et al. Routine ultrasound dating has not been shown to be more accurate than the calendar method. Br J Obstet Gynaecol 1997, Vol 104 No 11 pp1221-2

Rothman, Barbara Katz. *The Tentative Pregnancy: Amniocentesis and the Sexual Politics of Motherhood.* (2nd ed) Pandora 1994

Saari-Kemppainen A, Karjalainen O, Ylostalo P et al. Ultrasound screening and perinatal mortality: controlled trial of systematic one-stage screening in pregnancy. The Helsinki ultrasound trial. Lancet 1990 vol 336, no 8712. pp 387-391

Salvesen KA, Bakketeig LS, Eik-nes SH et al. Routine ultrasonography in utero and school performance at age 8-9 years. Lancet 1992, vol 339 no 8785 pp 85-89

Salvesen KA, Vatten LJ, Eik-nes SH et al. Routine ultrasonography in utero and subsequent handedness and neurological development. BMJ 1993: vol 307 no 6897 pp159-64

Salvesen KA, Ein-nes SH et al. Ultrasound during pregnancy and subsequent childhood non-right handedness - a meta-analysis. Ultrasound Obstet Gynecol 1999; 13(4) 241-6.

Sparling JW, Seeds JW, Farran DC. The relationship of obstetric ultrasound to parent and infant behavior. Obstet Gynecol 1988 vol 72 no 6. pp 902-7

Senate Community Affairs Reference Committee. *Rocking the Cradle - A Report into Childbirth Procedures.* Commonwealth of Australia 1999

Stark CR, Orleans M, Havercamp AD et al. Short and long term risks after exposure to diagnostic ultrasound in utero. Obstet Gynecol, 1984, vol 63 pp 194-200

Taylor KJW A prudent approach to ultrasound imaging of the fetus and newborn. Birth 1990. Vol 17 no 4, pp218-223

Testart J, Thebalt A, Souderis E, Frydman R. Premature ovulation after ovarian ultrasonography. Br J Obstet Gynaecol, 1982, vol 89, no 9, pp 694-700

Thacker SB. Quality of controlled clinical trials. The case of imaging ultrasound in obstetrics: a review. Br J Obstet Gynaecol, 1985 vol 92, no 5, pp 437-444

Wagner M. Ultrasound; More harm than good? Mothering magazine Winter 1995

Watkins D. An alternative to termination of pregnancy. The Practitioner, 1989, vol 233 no 1472, pp990, 992.