Transvaginal scanning – safety aspects (2012)

Introduction

The goal of transvaginal ultrasonography is to visualise and examine pelvic organs and structures from close up, with a minimum of soft tissue and intestinal intervention. B-mode imaging, colour flow mapping and pulsed Doppler techniques are all commonly used. There is often concern expressed that the technique of transvaginal ultrasound might entail high ultrasound exposures (as compared with those used in transabdominal ultrasonography) and thus the possibility of unwanted biological effects, especially in early pregnancy, in the ovary or the follicle. This fear arises for several reasons: the distance from the transducer to the target (embryo, fetus or follicle) is usually shorter than for transabdominal investigations, the whole embryo can be exposed to ultrasound during its most vulnerable stages of development, and the better visualisation afforded by the technique means not only that the embryo may be studied at earlier stages of gestation than was previously possible, but also that a higher number of early embryos is being examined.

Relative path lengths for transabdominal and transvaginal scans

Transabdominal scanning:

During transabdominal scanning, the ultrasound beam must pass through the abdominal and uterine walls. These tissue layers attenuate both the transmitted and the reflected beam. There is a large variation in tissue thickness, depending on the size and the weight of the woman, but path lengths are almost always longer for transabdominal scans than for transvaginal

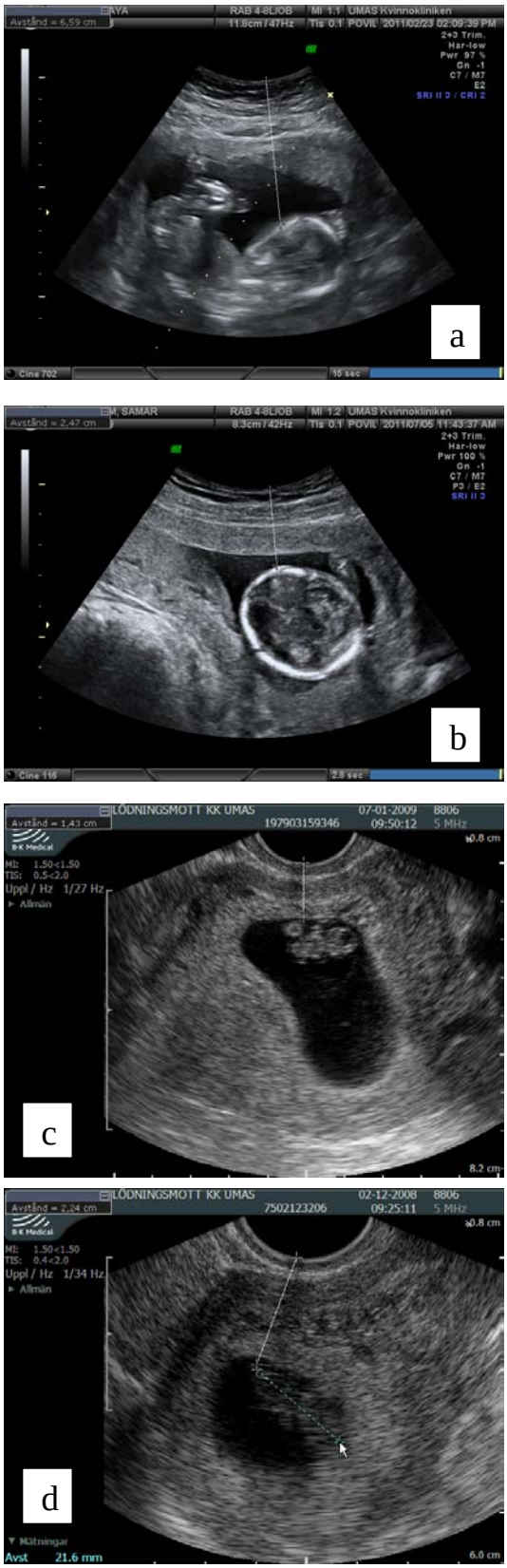

Figure 1. Ultrasound images of embryos/fetuses with the distance from the transducer to embryo/fetus marked in the upper left corner of the image at transabdominal scanning (a,b) and at transvaginal scanning (c,d).

scans (Figure 1). The `full bladder' technique is usually preferred for visualisation in the first trimester of pregnancy. Although this increases the distance to the target (embryo or fetus), the urine and amniotic fluid present very little attenuation to the ultrasound beam.

Transvaginal scanning

It is usually preferred to perform a transvaginal scan on a patient with an empty bladder. Amniotic fluid is usually present between the embryo or fetus and the uterine wall. During the first trimester of pregnancy, the thickness of the uterine and vaginal walls together may be 2-4 cm. There appears to be little variation with the size and weight of the woman. In the second and third trimester of pregnancy, the uterine wall becomes thinner by extension and stretching of the isthmic portion. The distance to the presenting fetal part (head, breech) or amniotic fluid, varies from about 2 cm to less than 1 cm (Figure 1).

Imaging mode:

If the exposure conditions were the same for transvaginal scanning as for transabdominal scanning, `in situ' exposure to the embryo or fetus would indeed be higher for transvaginal scanning because of the generally shorter attenuation path. However, there are differences in the exposure conditions as follows:

(a) Since the path lengths for the transmitted and received beams are both much shorter, for transvaginal applications lower output intensities can be used. Measurements available at present of ultrasound fields of commercial equipment confirm that this is the case.

(b) For transvaginal applications, the short path length to the target means that higher frequencies can be used than for transabdominal applications. This results in higher image resolution. However, the use of higher frequencies results in increased absorption in the intervening tissue layers en route to the embryo or fetus. The exposure levels at the embryo (or fetus) can be estimated to be similar for transvaginal and transabdominal scanning.

(c) The higher frequency transducers used for transvaginal scanning produce shorter wave lengths and narrower beams than those used for transabdominal scanning. These features, and the facility for real time dynamic focusing, mean that there is an improvement in near field visualisation and greatly improved axial and lateral resolution. Better visualisation and resolution mean that faster answers can be obtained to clinical questions, and thus the examination time can be reduced.

Pulsed Doppler and colour flow mapping:

The exposure levels and intensities of pulsed Doppler systems are generally higher than those of B-mode imaging systems. The values for colour Doppler lie somewhere between the two. This is because for pulsed Doppler the beam direction is stationary whereas for colour flow mapping the scan line direction is continuously changing. Safety aspects of pulsed Doppler have been discussed in a separate Safety Committee tutorial article. However, there are large variations in exposure conditions between different systems and different transducers.

Safety Implications

For transvaginal sonography, the ultrasound probe (or transducer) is gently introduced into the vagina, as far as the vagina fornices and cervix uteri, in order to get close to the uterus, the uterine contents and the adnexal regions. This approach is different from transabdominal scanning in several ways. Safety for the fetus, mother and operator relates to more

than ultrasonic exposure and, therefore, the patient should fully accept the procedure. The probe must be covered with an aseptic sheath, the introduction of the probe must be painless and atraumatic, and the probe must be electrically safe. There are conditions under which the electrical safety of a probe may be jeopardized, for example, if the probe has been dropped, or the transducer housing has been cracked. In this case the electrical safety of the device should be checked before re-use. Exceptional self-heating of the transducer might be an effect of which the clinician should be aware.

Conclusions and recommendations

Imaging

Information available at present, either from acoustic output data from commercial equipment, or from calculations of embryonic exposures, do not provide any contra-indications for transvaginal ultrasound scanning when clinically indicated, or for early pregnancy screening when there are firm clinical grounds.

The absence of long-term, large scale, follow-up studies following first-trimester ultrasound exposures means that care is required in the application of transvaginal ultrasonography in early pregnancy. It should only be performed for pure medical reasons that are to the benefit of the mother and/or the embryo. The power settings and the exposure times should be kept as low as possible whilst still providing an answer to the clinical question.

Pulsed Doppler and colour flow mapping:

In view of the possibility of significant temperature elevations in utero, routine examination with Doppler of every embryo/fetus is considered inadvisable at present. (This is a reiteration of the recommendation put forward in the Safety Committee tutorial article on Doppler ultrasound, and in the 2011 Clinical Safety statement of EFSUMB). If the clinician judges it as essential to scan the fetus or embryo with pulsed Doppler or colour flow Doppler, the output parameters should be kept as low as possible.

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Suggested Reading

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