The British Medical Ultrasound Society.

Guidelines for the safe use of diagnostic ultrasound equipment

Prepared by the Safety Group of the British Medical Ultrasound Society.

Part I: Basic guidelines

The following Basic Guidelines should be read in conjunction with **Detailed guidelines for the safe use of diagnostic ultrasound equipment** (see Part II. www.bmus.org)

Key principles for the safe use of ultrasound

- Medical ultrasound imaging should only be used for medical diagnosis.
- Ultrasound equipment should only be used by people who are fully trained in its safe and proper operation. This requires:
  - an appreciation of the potential thermal and mechanical bio-effects of ultrasound,
  - a full awareness of equipment settings
  - an understanding of the effects of machine settings on power levels.
- Examination times should be kept as short as is necessary to produce a useful diagnostic result.
- Output levels should be kept as low as is reasonably achievable whilst producing a useful diagnostic result.
- The operator should aim to stay within the BMUS recommended scan times (especially for obstetric examinations).
- Scans in pregnancy should not be carried out for the sole purpose of producing souvenir videos or photographs.

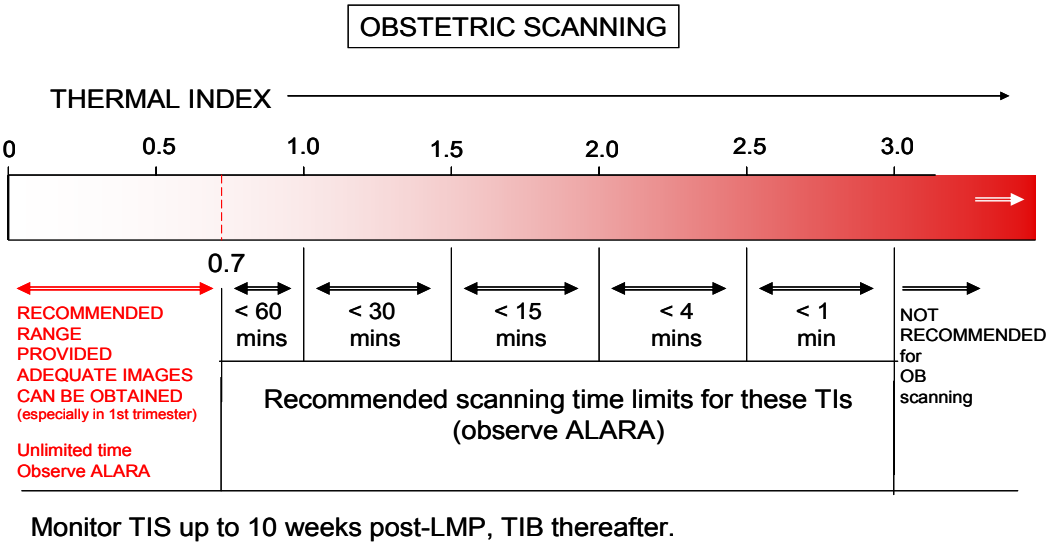

Figure 1. Recommended maximum scanning times for obstetric examinations conducted with different displayed Thermal Indices (TI). Full information on the recommendations for obstetric and non-obstetric examinations can be found in the Detailed Guidelines.

Background

Diagnostic ultrasound is an imaging modality that is useful in a wide range of clinical applications, and in particular, prenatal diagnosis. There is, to date, no evidence that diagnostic ultrasound has produced any harm to humans (including the developing fetus).

Despite its apparent excellent safety record, ultrasound imaging involves the deposition of energy in the body, and should only be used for medical diagnosis, with the equipment only being used by people who are fully trained in its safe and proper operation. It is the scan operator who is responsible for controlling the output of the ultrasound equipment. This requires a good knowledge of scanner settings, and an understanding of their effect on potential thermal and mechanical bio-effects.

A fundamental approach to the safe use of diagnostic ultrasound is to use the lowest output power and the shortest scan time consistent with acquiring the required diagnostic information. This is the ALARA principle (i.e. as low as reasonably achievable). It is acknowledged, that in some situations it is reasonable to use higher output or longer examination times than in others: for example, the risks of missing a fetal anomaly must be weighed against the risk of harm from potential bioeffects. Consequently, it is essential for operators of ultrasound scanners to be properly trained and fully informed when making decisions of this nature.

The Thermal Index (TI) and Mechanical Index (MI) were introduced to provide the operator with an indication of the potential for ultrasound induced bio-effects. TI provides an on-screen indication of the relative potential for a tissue temperature rise. MI provides an on-screen indication of the relative potential for ultrasound to induce an adverse bio effect by a non thermal mechanism such as cavitation. Three forms of the TI may be displayed:

1. The thermal index for soft tissue (TIS). This is used when ultrasound only insonates soft tissue, as, for example, during obstetric scanning up to 10 weeks after last menstrual period (LMP).
2. The thermal index for bone (TIB). This is used when the ultrasound beam impinges on bone at or near its focal region, as, for example, in any fetal scan more than 10 weeks after LMP.
3. The thermal index for cranial bone (TIC). This is used when the ultrasound transducer is very close to bone, as, for example, during trans-cranial scanning of the neonatal skull.

Obstetric Examinations

Any potential bio-effects are likely to be of greatest significance in the embryo or fetus. Thus when undertaking obstetric scans, the restrictions to scanning times detailed in Figure 1 are recommended. These have been formulated on the basis of potential thermal effects arising from the scan, and are therefore based on the Thermal Index (TI) displayed.

MI values should be kept as low as reasonably achievable, consistent with the need to obtain diagnostically satisfactory images.

More detail can be found in the Detailed Guidelines.

Non-obstetric Examinations

Most other types of examination are of less concern than are obstetric scans. Specific guidance on a range of non-obstetric examinations (including gynaecological, neonatal, ophthalmic, general abdominal, cardiac etc.) can be found in the Detailed Guidelines.