Infrared Colour Mammography (Transillimination Light Scanning) for Screening Of Breast Cancer

SERIAL NO : **013/06**
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1. INTRODUCTION

Currently the most effective screening and clinical tool for breast cancer is x-ray mammography. However, x-ray mammography exposes the patient to ionizing radiation, causing cancer risk induction. Optical imaging has potential to be considered as alternative tool (Franceschini MA et al., 1997). The idea of optical imaging had been around for many decades. However there has not been much development of an effective method. Optical imaging presents several potential advantages over existing radiological techniques.

i. The radiation is non ionizing, reasonable doses can be repeatedly employed without harm to the patients.
ii. Optical methods offer the potential to differentiate between soft tissue with different optical absorption or scatter, but are indistinguishable using other modalities.
iii. Specific absorption by natural chromophores (such as haemoglobin) allows functional information to be obtained (Franceschimi MA et al., 1997 and Hebden JC and Deply DT, 1997).

Past attempts to image tissues with light have been restricted by the scatter, which occurs when optical radiation spreads through tissue. Recent innovations have suggested that the technology might have practical possibility (Hebden JC and Deply DT, 1997)

2. OBJECTIVE

To assess the effectiveness, cost effectiveness and safety of transillumination light scanning in screening examination for breast cancer.

3. TECHNICAL FEATURES

Transillumination, also previously known as Diaphanography, is a breast diagnostic technique based on differences in the diffuse transmittance of visible or near-infrared radiation.

Transilumination light scanning is a non-x-ray, noninvasive modality that uses low-intensity emissions of red and near infrared light to visualize the tissues of the breast. The absorption characteristics of the emitted light from the breast tissues are fed into a computer that transforms the analog signals into varying degrees of color saturations hues, ranging from blue to red. Abnormal or maglinant breast tissues appear blue on the light scan, while normal breast tissues appear red (HTA Report, 1998).

Transillumination, is the passage of light through body tissues or cavities in order to examine their internal structure. Transllumination encompasses a vast of different techniques. In radiology, transillumination has been used mostly for the detection of breast cancer. In the early 1970s, this was performed with a high-intensity light source and the transmitted light was recorded on photographs. The technique was further improved by using infrared-sensitive film ("doaphanograph"), and later (in 1981) by viewing the transilluminated breast with a red-near-infrared sensitive television camera, the breast being scanned with two narrow bands of light; red and near-infrared. Light-scanning provides information on the transmitted light intensity and on the differential absorption of the two wavelengths. The mechanism of tumor detection is partly dependent on vascularization, the light being absorbed by haemoglobin. Due to scattering of the light, the spatial resolution of light-scanning is rather poor. Laser transillumination can be divided into two major groups: frequency-domain and time-domain methods. Both use extremely short (femtosecond – picosecond) laser pulses and a time-resolved detection. Frequency-domain methods apply intensity – modulated pulsed laser and detect changes in amplitude and phase after transmission. The measured amplitude and phase may enable discrimination of the specific depth and lateral position of an absorbing body. Time-domain methods use a time-correlated, single-photon counting technique to detect the first arriving photons received after transmission. Scattering of the light photons is a major problem in transillumination, and this is partly overcome by selective detection of the photons that first arrive at the detector after transmissionof a laser pulse. The photons arriving first are assumed to have traveled the straight and shortest path, i.e. with the least scattering. Detection of the "early light" may improve contrast and spatial resolution in transillumination images. Time-resolved transillumination tomographic scanning has been developed and images with a better than 1 cm have been produced. Some time-resolved transillumination technique use lasers with a fixed wavelength in the near-infrared range, others use laser pulses of white light, i.e. light containing the entire visible and near-infrared frequency range. White light lasers make possible simultaneous multispectral transillumination (also called multiwavelength spectroscopy).

4. METHODOLOGY

Retrieval of evidence :-

i. MEDLINE database has been searched. All studies were included in the searched, with no limits in language, year of publication. Keywords used were optical imaging. Breast cancer, breast transillumination, transillumination light mammography, effectiveness and safety. From 41 abstract collected 16 were relevant.
ii. HRA database were also searched – no article found.
iii. General websites searched – few articles for used in introduction.

5. RESULTS AND DISCUSSION

5.1 Safety

There is no evidence of safety for this topic.

5.2 Effectiveness

Lightscanning of the breast was tested against mammography in 2568 women in a Swedish multicentre study. Lightscanning is found to be no better than mammography in young women, and the study showed that lightscanning in its current form is inferior to standard mammography (Alveryd A et al., 1990).

However, in a case series Laser transmission photoscanning (LTPS) was shown to have a high sensitivity towards haemorrhagic cysts, early age fibrioadenomas, adenosic dysplasia, hematomas as well as carcinomas (Spinelli C et al., 1991). In an audit of a breast cancer-screening program, using clinical examination and lightscanning, light scanning proved to be unsatisfactory screening test (Braddick MR, 1991). Lightscanning mainly failed to identify ductal and lobular carcinomas in situ, and also poor in detecting small invasive carcinomas (Jarlman O el al., 1992a). The diagnostic accuracy and light scanning and mammography were invested in breasts with mammographically dense parenchymal patterns. Thus, light scanning has the same sensitivity as mammography in detecting cancer in mammographically dense breasts. However its usefulness is limited by high rate of false positives (Jarlman O et al., 1992b). A time gated optical imaging technique as a tool for imaging human breast was tested. Results showed that time gated optical imaging can image oxygen concentration in the cancerous and fibrotic breasts. Resolution for smaller tumor size needs to be improved (Nioka S et al., 1994). A new breast imaging method with the potential of multi-spectral optical transillumination showed that simultaneous, multi-spectral transillumination is possible. The technique can also be used for measurements of optical properties in tissue (Jarlman O et al., 1997).

A frequency domain optical scanner performs a transillumination scan of the female breast using dual wavelength light probe. The initial clinical results shoe that the frequency – domain scanner even at the present stage of development, has the potential to be a useful tool in mammography (Franceschini MA et al., 1997). Michaelson K, et al (1997) discussed simulation technique to explore the possibility of locating millimeter0sized objects, immersed in turbid media, from tome-gated measurements of the transmitted or reflected light. This technique showed that it is possible to detect objects of a 1 mm diameter and provide new possibilities for medical diagnosis of breast cancer at an early stage (Michealson K, et al., 1997). The use of pre operative optical imaging for improving diagnostic accuracy in breast imaging is not sufficient developed and well tried for clinical use. Future research might consider the development of tumor-specific contrast media (Gotz L et al., 1998).

Frequency-domain photon migration (FDPM) utilizes intensity-modulated, near-infrared (NIR) light to quantitatively measure optical properties in thick tissues. Results of clinical studies

showed that tumor growth is detectable using photon migration techniques (Tromberg BJ et al., 2000).

The in vivo images of human breast were obtained by using near-infrared diffuse optical tomography (DOT) after the administration of indocyanine green (ICG) for contrast enhancement. DOT provides localization and quantification of exogenous tissue chromophore concentrations and with ICG, there is a potential in differenting disease based on the quantified enhancement of suspicious lesions (Ntziachristos V et a., 2000).
Near-infrared diffuse optical imaging may offer enhanced contrast resolution over that of the existing technologies for detection and diagnosis of breast cancer. The results of this pilot study show that cancers as small as 5 mm can be quantitatively imaged. In addition, preliminary data from the scattering images suggest that benign and maglinant tumors can be non-invasively differentiated with optical imaging (Jiang H et al., 2002).

5.3 Cost Effectiveness

There is no evidence on cost effectiveness.

6. CONCLUSION

Although there is evidence of its possible use as a diagnostic tool in detecting breast cancer, studies done are mostly in computer simulation forms, designs or models. In studies such as case series and a few clinical studies, results showed that lightscanning proved to be an unsatisfactory screening test, failed to identify certain form of cancer, with high rates of false positives and inability to detect small tumors.

7. RECOMMENDATION

Lightscanning is not recommended for screening of breast cancer.

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