Feasibility of US-guided Radiofrequency Ablation in treatment of early Breast Cancer

Essay

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BY

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TABLE OF CONTENTS

LIST OF ABBREVIATIONS

- **ABBI** Advanced breast biopsy instrumentation
- **ATEC** Automatic Tissue Extraction and Collection
- **BCS** Breast conserving surgery
- **BCT** Breast conserving surgery
- **CNB** Core needle biopsy
- **CT** Computed tomography
- **DCIS** Ductal carcinoma in situ
- **ER** Estrogen receptor
- **FNAC** Fine needle aspiration cytology
- **FUS** Focused ultrasound
- **H&E** Haematoxylin and eosin
- **HIFU** High intensity focussed ultrasound
- **LCIS** lobular carcinoma in situ
- **MIBB** Minimally invasive breast biopsy
- **MRI** Magnetic resonance imaging
- **NADH** Nicotinamide adenine dinucleotide
- **NOS** Not other wise specfied
- **PR** Progesterone receptor
- **RFA** Radiofrequency ablation
- **SLCB** Single large core biopsy

- **TDLU** terminal duct lobular unit
- **US** Ultrasound
- **VAM** Vacuum assisted mammotome

LIST OF FIGURES

LIST OF TABLES

Abstract

Since the use of radical mastectomy, new treatments have been developed to reduce the amount of tissue removed during surgery resulting in a better cosmetic outcome. The surgical treatment for small breast cancer nowadays is mostly lumpectomy followed by radiotherapy. This procedure is combined with sentinel lymph node mapping which decreases the number of unnecessary axillary lymph node dissections. Randomized studies have documented similar survival rates between patients undergoing radical or modified radical mastectomy and breast conserving therapy .As the management of breast cancer evolves towards less invasive treatments, several techniques have been developed to improve local eradication of breast tumours. One of the most promising of the non-invasive ablation techniques is radiofrequency ablation (RFA). RFA is produced by frictional heating. Electrode tips placed in the lesion produce a high-frequent current that flows into the surrounding tissue initiating ionic agitation that causes heat and, in the end, cell destruction. RF ablation is a promising minimally invasive treatment of small breast carcinomas, as it can achieve effective cell killing with a low complication rate. Further research is necessary to optimize this image-guided technique and evaluate its future role as the sole local therapy. However , non-surgical ablation techniques still have a number of problems with regard to determination of 100% tumor cell killing and assessment of tumor margins and ability to follow local recurrence. To achieve wide acceptance, non-surgical ablation techniques must achieve results equivalent to those of conventional breast conserving treatment (BCT) in local control and survival.

Keyword breast cancer - RFA – minimally invasive ablation techniques

Introduction:

The surgical management of breast cancer has gradually evolved over the past century from the exclusive use of radical mastectomy to the present-day prevalence of segmental mastectomy followed by adjuvant radiation and/or chemo-therapy.***(Ahmed and Goldberg ,2004)***

Since the original description of radical mastectomy, there have been continued efforts to reduce the amount of tissue removed during the surgical treatment of small breast cancer. Currently, the standard surgical treatment for early stage (T1N0M0) cancer is lumpectomy followed by radiation therapy . There is a similar trend to decrease the number of unnecessary axillary lymph node dissections through the widespread use of sentinel lymph node mapping. ***(Fornage et al , 2004)***

Randomized studies have documented similar survival rates between patients undergoing radical or modified radical mastectomy and breast conserving therapy. (***Fisher et al, 1995)***

Within the context of minimally invasive treatments for breast diseases in general and breast cancer in particular, there are several proposed image-guided techniques. Such currently available technologies include cryotherapy and hyperthermia with use of laser irradiation , microwaves , high-intensity focused US waves , and radiofrequency (RF) electrical currents . ***(Fornage et al , 2004)***

Introduction

Within all minimally invasive approaches used in the treatment of early-stage breast cancer, the most extensive work and progress have been made with RFA. RFA destroys the tumor with heat. A radiofrequency probe (15-gauge) with RFA electrodes is inserted in the tumor, and an alternating high-frequency electric current (400–500 kHz) is administered. The heat that is generated affects the cell membrane's fluidity and the cytoskeleton proteins and finally acts on the nuclear structure, resulting in the interruption of cell replication . This finally leads to irreversible tumor destruction, as tumor cells are more susceptible to heat than are normal cells. ***(Vlastosa et al , 2007)***

The main inclusion criteria was the presence of an invasive breast cancer of 2.0 cm or less in greatest diameter. The tumor had to be clearly identified and unequivocally measurable at US. To avoid the risk of injury to the skin and the chest wall, a distance of at least 1 cm between the tumor and the skin and between the tumor and the chest wall was required.***(Fornage et al , 2004)***

There is increasing demand for minimally invasive and non-surgical treatment methods for patients with small breast cancer. Radiofrequency (RF) ablation is the most promising among several non-surgical ablation techniques in the treatment of breast cancer. Several pilot studies of RF ablation therapy are currently in progress in Japan as well as USA. However, non-surgical ablation techniques still have a number of problems with regard to (a) inability to precisely determine tumor size, (b) determination of 100% tumor cell killing, (c) ability to follow local recurrence, and (d) cosmetic outcome. To achieve wide acceptance, non-surgical ablation techniques must achieve results equivalent to those of conventional breast conserving treatment (BCT) in local control and survival. ***(Noguchi et al , 2006)***

RF ablation is a promising minimally invasive treatment of small breast carcinomas, as it can achieve effective cell killing with a low complication rate. Further research is necessary to optimize this image-guided technique and evaluate its future role as the sole local therapy.***(Khatri et al , 2007)***

Aim of the study :

To determine the feasibility and safety of ultrasonographically (US) guided percutaneous radiofrequency (RF) ablation in the local treatment of invasive breast carcinomas 2 cm or less in greatest diameter .A review of literature regarding all aspects of the technique will be analyzed .

Anatomical background

DEVELOPMENT:

The mammary line (crest, ridge) is an ectodermal (epidermal) thickening that appears during the 4th–5th week of development. It extends from axilla to groin, on each side of the body (Fig.1). only a small portion of the line persists in the thoracic region**.*****(Sadler, 2004).***

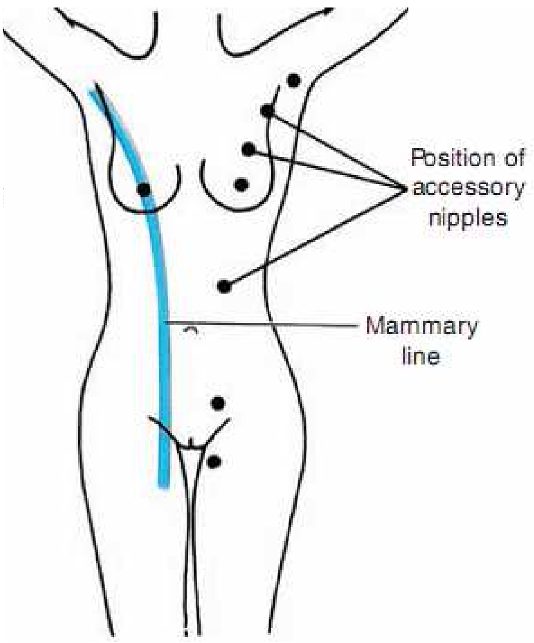
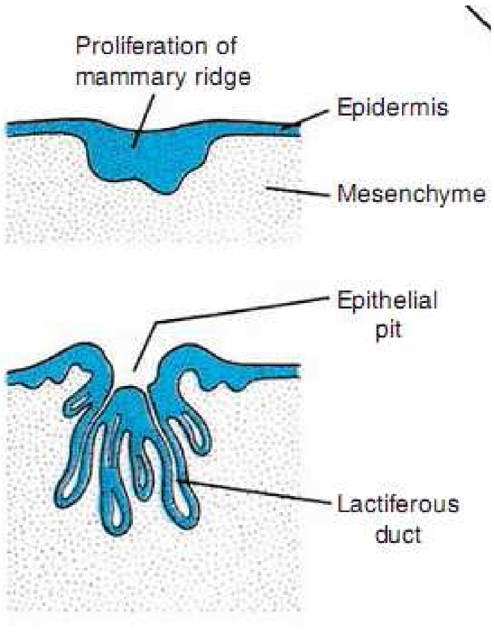


Fig.1.The position of the mammary line ***(Sadler, 2004)***.

Invasion of the underlying mesenchyme (dermis) in the 6th week gives rise to the mammary buds. These lengthen, branch and are canalised to form the lactiferous ducts. The lactiferous ducts come together in a depression on the surface of the skin called the mammary pit. Shortly after birth the pit is converted to the nipple (Fig.2) ***(Moore and Persaud, 2003).***



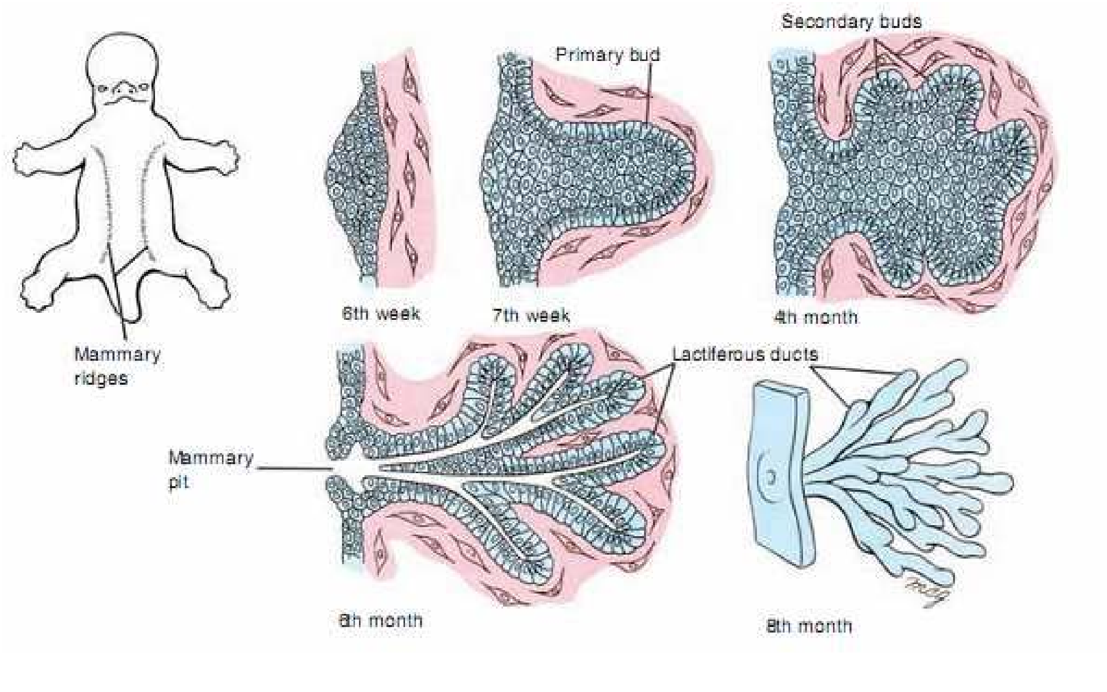


Fig.2 The development of the mammary gland tissue ***(Larsen, 1993)***.

Persistence of remnants of the mammary line may give rise to accessory nipples (polythelia). They are found along of the mammary line and are commonly mistaken for moles. An extra breast develops if a remnant of the mammary line completely develops into a breast (polymastia) . Amastia is the congenital