Diffuse reflectance spectroscopy measurements during a ultrasound guided vacuum assisted excision procedure of breast tumors

Published: 24-09-2021
Last updated: 25-03-2025

This study consists of two phases. The first phase includes a pilot study for the feasibility of using this new developed smart VAE device. If this pilot study is successful we will continue to the second phase. This phase includes a proof of...

Ethical review	Approved WMO
Status	Pending
Health condition type	Breast therapeutic procedures
Study type	Interventional

Summary

ID

NL-OMON56338

Source
ToetsingOnline

Brief title
Minimal invasive breast cancer treatment

Condition

- Breast therapeutic procedures

Synonym
Breast Cancer, Invasive Carcinoma

Research involving
Human

Sponsors and support

Primary sponsor: Antoni van Leeuwenhoek Ziekenhuis

Source(s) of monetary or material Support: KWF grant

Intervention

Keyword: Breast cancer, Diffuse reflectance spectroscopy, Minimal invasive, Vacuum assisted exision

Outcome measures

Primary outcome

In this proof of concept study (phase 1), we will use the tissue sensing VAB device with integrated DRS technology for ultrasound-guided VAE of small breast tumors. The goal of this study is to assess whether it is feasible and intuitive to perform DRS measurements in combination with a vacuum-assisted excision procedure. The main study endpoint is the usability and functionality of DRS in combination with a vacuum-assisted excision procedure. The ease of use of the developed tissue sensing VAB device will be reported by the involved radiologist(s). When necessary this information will be used to improve the functionality and optimize the design of this device for the next phase of this study.

When phase 1 of the study is finished successfuly, defined as a 70% satisfacory scoring on the SUS scoring scale, we will proceed to phase 2 of the study. In this proof of concept study, we will use the definite sensing VAB device with integrated DRS technology for ultrasound-guided VAE of small breast tumors and will use a tissue sensing algorithm developed earlier in our group to guide the procedure.

The aim of this study is to show that such a *smart* VAE procedure is safe and effective. Critical to this approach is to achieve a comparable radical resection rate to BCS. To this end, we will investigate the success rate of complete tumor excision by the *smart* VAE procedure by confirmatory surgery of the VAE excision cavity 3 weeks after the VAE procedure. Success will be defined as the absence of residual cancer tissue in the resected VAE cavity. It is hypothesized that the addition of tissue sensing technology to the standard VAE procedure can achieve a complete tumor removal success rate of 95%. The success rate of complete tumor removal will be determined by assessing the presence or absence of residual tumor tissue in the specimen of the resected VAE cavity.

Secondary outcome

Only for phase 2 of the study:

A time frame of 3 weeks between VAE and confirmatory surgery (instead of immediate excision) allows us to register short-term complications such as post-procedural pain, hematoma and infection. The secondary endpoint includes the results of questionnaires concerning complications, pain during and after the procedure, patient satisfaction, and short term cosmetic outcome.

Study description

Background summary

The current treatment of breast cancer by breast-conserving surgery (BCS) plus radiotherapy shows excellent local tumor control rates, but comes at the cost

of an invasive procedure under general anesthesia (also for small tumors) and still comprises patient*s satisfaction by suboptimal cosmetic outcome, scar tissue, and local painful breasts.

This raises the question of whether for patients with small breast tumor surgery can be replaced by image-guided minimal invasive radiological procedures that, like BCS, in combination with radiotherapy, may result in equal local control rates, but a better cosmetic outcome, less scar tissue and fewer complaints of painful breast areas. Since such procedures can be performed under image guidance, optimal cosmetic results can be obtained by more precise tumor excision while sparing more healthy breast tissue. Moreover, such procedures can be performed under local anesthesia in an outpatient setting and would also obviate the need for additional tumor localization techniques by guide wires or radioactive I-125 and magnetic seeds.

However, the widespread use of this technology for breast cancer is hampered by the lack of quality control during the procedure, as definite histopathological information on whether all tumor is removed is lacking. Without such real-time histopathological control, the medical community is reluctant to further apply VAE technology for malignant breast lesions. In this project, we will solve the quality control issue by using optical technology for real-time tissue sensing during the ultrasound-guided VAE procedure. In this way, we will be able to predict the margins of the excised tumor and assess whether minimal invasive treatment of breast cancers by VAE is successful, and all tumor tissue is removed adequately.

To this end, we developed a tissue sensing introducer with integrated optical fibers that enable diffuse reflectance spectroscopy (DRS) measurements. The developed tissue sensing introducer can be used in conjunction with a standard vacuum-assisted biopsy (VAB) needle to form a smart tissue sensing VAE device suitable for tumor excision. DRS is a light-based technology that enables discrimination of tissue types based on their optical characteristics. The DRS measurements reflect functional, biochemical and morphologic information of measured tissue and in that way are able to discriminate tumorous tissue from healthy tissue. DRS technology has already been successfully evaluated in multiple oncological domains for discriminating tumor tissue from healthy tissue with classification accuracies of 0.86-1.00. The advantages of DRS are that it is non-destructive, does not require exogenous contrast with dyes, and has the potential to be performed in real-time.

In our previous studies, we show that fiber-optic DRS is able to detect invasive carcinoma (IC) and Ductal Carcinoma In Situ (DCIS) ex-vivo and in-vivo with high accuracies (93-100%) without the substantial influence of patient factors such as menopausal status and neoadjuvant chemotherapy. Our result mainly relies on the NIR wavelength range, which eliminates the influence of blood on the measurements, which is of great benefit for in-vivo measurements during surgery or VAE. Moreover, we showed the feasibility of DRS integration

in a standard biopsy needle, able to perform continuous DRS measurements during ultrasound-guided biopsies and capable of detecting cancerous tissue at the biopsy site.

With DRS measurements (derived from ex-vivo breast specimen), a real-time tissue classification algorithm was developed for the discrimination of tumor from healthy breast tissue using the optical introducer. In this study, we will investigate the feasibility and efficacy of the tissue sensing VAB device during an ultrasound-guided VAE procedure (in-vivo). Real-time tissue sensing during the VAE procedure should be easy to handle and intuitive and allowing assessment of the excision margins and hence guarantee radical tumor excision.

Study objective

This study consists of two phases. The first phase includes a pilot study for the feasibility of using this new developed smart VAE device. If this pilot study is successful we will continue to the second phase. This phase includes a proof of concept study performed on a larger patient group.

Phase 1
Primary Objective:
The primary objective of this study is to assess usability of performing DRS measurements in combination with a vacuum-assisted excision procedure.

Phase 2
Primary Objective:
To determine whether ultrasound-guided vacuum-assisted tumor excision (VAE) by the sensing VAB device (smart VAE) results in complete removal of malignant breast tumors.

Secondary Objective(s):
The secondary objective includes the evaluation of complications, pain during and after the procedure, patient satisfaction, and short-term cosmetic outcome.

Study design

The first phase study is designed as a feasibility study and is part of the ongoing product development cycle. A product development cycle was used to design and manufacture an ultimate VAB tool (tissue sensing introducer) suitable for the clinical setting planned in this project. Adding DRS tissue sensing functionality to a VAB device is challenging, as vacuum suction mechanisms and the location of the needle aperture set strict constraints for integrating the optical fibers within the device. The developed tissue sensing introducer turns a standard VAB device in a smart VAE device, making DRS measurements during the excision procedure possible. However, the design and methodology need to maintain the full functionality of the VAB system as well

as the DRS system.

In this phase we want to assess the usability and functionality of this newly designed tissue sensing introducer with integrated optical fibers. Therefore, a variety of patients will be treated with different breast sizes, breast density and ultrasound features of the tumors to obtain sufficient initial experience on the feasibility. The procedure will be performed within the OR under general anesthesia. In the normal situation patient would undergo a standard wide local excision of the breast lump. In this study, initially an ultrasound-guided vacuum-assisted excision (VAE) procedure will be performed followed by excision of the biopsy cavity or removal complete breast. In this way it is guaranteed that the tumor is completely removed in a way comparable to the standard wide local excision or mastectomy. The main study endpoint is the usability and functionality of DRS measurements in combination with a vacuum-assisted excision procedure. The ease of use of the developed tissue sensing VAE device will be reported by the involved radiologist(s). This information will be used to improve the functionality and optimize the design for this device for the second phase of this study.

For the second phase of this study, we will perform a proof of concept study. In this proof of concept study, we will use the sensing VAB device with integrated DRS technology for ultrasound-guided VAE of small breast tumors and will use the tissue sensing algorithm developed and validated in earlier study to guide the procedure. The aim of this study is to show that such a *smart* VAE procedure is safe and effective. Critical to this approach is to achieve a comparable radical resection rate to BCS. To this end, we will investigate the success rate of complete tumor excision by the *smart* VAE procedure by confirmatory surgery of the VAE excision cavity 3 weeks after the VAE procedure. Success will be defined as the absence of residual cancer tissue in the resected VAE cavity. A time frame of 3 weeks between VAE and confirmatory surgery (instead of immediate excision) allows us to register short term complications such as post-procedural pain, hematoma and infection. After the VAE procedure and confirmatory surgery (wide local excision plus sentinel node procedure), patients will further be treated with adjuvant radiotherapy like in standard BCS.

Intervention

During the first phase of this study, we want to assess the usability and functionality of the newly developed tissue sensing introducer with integrated optical technology. For this, a variety of patients with different breast size, breast density and ultrasound characteristics of the tumor will be treated. The procedure is performed in the operating room under general anesthesia. In the normal situation, the patient would undergo a standard local excision (lumpectomy). In this study, an ultrasound-guided vacuum-assisted excision (VAE) procedure will be performed initially, followed by surgical excision of the biopsy cavity or removal of the complete breast. In this way, it is ensured

that the tumor is completely removed in a manner similar to the already planned lumpectomy or mastectomy.

In the second phase of this study, we want to use an ultrasound-guided vacuum-assisted excision procedure for the complete removal of the breast tumor. This will be performed in an outpatient setting. After a local anesthetic, the radiologist will make a small incision to insert the biopsy needle in the breast. The entire tumor will be removed using the tissue sensing introducer. After the procedure, the patient can go home immediately. 3 weeks after the procedure, the patient is admitted for planned breast conserving surgery (lumpectomy). In this way, it is ensured that the tumor area will be removed completely. The patient completes a questionnaire after the VAE procedure, which makes it possible to monitor minor complications of the treatment.

Study burden and risks

Phase 1 of this research:
The vacuum assisted excision procedure takes place under general anesthesia in the operating room. The planned breast-conserving or mastectomy procedure follows immediately after the procedure. Besides the (already known) risks of this standard procedure, there are no additional risks for the patient. The patient will be under anesthesia for 20 extra minutes.

Phase 2 of this research:
The vacuum-assisted excision procedure takes place under local anesthetic in the radiology department. The patient can experience some discomfort after the procedure which is related to minor pain and / or bruising (hematoma) at the site of the treatment. In very minor cases, infection of the entrance wound can occur. In addition, the patient needs one extra hospital visit for this procedure and a questionnaire must be completed afterwards.

Contacts

Public
Antoni van Leeuwenhoek Ziekenhuis

Plesmanlaan 121
Amsterdam 1066 CX
NL
Scientific
Antoni van Leeuwenhoek Ziekenhuis

Plesmanlaan 121

Amsterdam 1066 CX
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

Major inclusion criteria BCS patients phase 1:
• Woman, >= 18 years old
• Histology proven invasive ductal carcinoma of the breast planned for BCS
• Lesion visible on ultrasound
• Lesions size <= 25 mm on MRI and US
• No associated mammographic microcalcifications outside the lesion
• Lesion >= 6mm distance from dermis, nipple or pectoral muscle
• Normal axillary ultrasound
• Written informed consent

Major inclusion criteria mastectomy patients phase 1:
• Woman, >= 18 years old
• Histology proven invasive ductal carcinoma of the breast planned for mastectomy
• Lesion visible on ultrasound
• Lesions size <= 25 mm on MRI and US
• Written informed consent

Major inclusion criteria for phase 2 are the same as phase 1 (patients scheduled for BCS) with an additional inclusion criterium:
• Patients with invasive ductal carcinomas only and an ERpos /HER2neg tumor type.

Exclusion criteria

Poor ultrasound visibility of the lesion
Patients with breast implants
History of breast related radiotherapy treatment
Previous breast surgery
Suspected oversensitivity to light; e.g. patient who has had photodynamic therapy
Pregnancy

Study design

Design

Study type: Interventional

Masking:	Open (masking not used)
Control:	Uncontrolled
Primary purpose:	Treatment

Recruitment

NL

Recruitment status:	Pending
Start date (anticipated):	01-07-2021
Enrollment:	78
Type:	Anticipated

Medical products/devices used

Generic name:	Optical Introducer
Registration:	No

Ethics review

Approved WMO

Date:	24-09-2021
Application type:	First submission

Review commission:	METC NedMec
Approved WMO Date:	14-09-2023
Application type:	Amendment
Review commission:	METC Universitair Medisch Centrum Utrecht (Utrecht)
Approved WMO Date:	27-02-2025
Application type:	Amendment
Review commission:	METC Universitair Medisch Centrum Utrecht (Utrecht)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL77581.031.21