Master track Medical Imaging and Intervention

Decreasing intervention time with the addition of microbubbles to High Intensity Focused Ultrasound for HepatoCellular Carcinoma treatment

Groep 1; Mirthe van Erp, Lidewij Neeter, Gerard Snaauw, Nathalie Versteeg

Abstract
A challenge in using HIFU on HCC is decreasing the intervention time. In this paper we will look at the effect of microbubbles in combination with HIFU on a HCC. We have investigated which microbubbles are clinically applicable, how microbubbles influence the tissue and how microbubbles can be directed to the target site in order to save time. This all resulted in the following research question: Can the addition of microbubbles decrease the intervention time for hepatocellular carcinoma (HCC) with High Intensity Focused Ultrasound (HIFU)?

Which improvements on MRgFUS can be done to reduce problems caused by liver motions in treating hepatocellular carcinoma?

Groep 2; Astrid Hoving, Eliane Nieuwenhuis, Daan Spoor, Levinia ven der Velden

Abstract
Problems caused by liver motion is one of the reasons that the use of MRgFUS for the treatment of hepatocellular carcinoma is not realised in clinical practice yet. This motion leads to difficulties in aligning beam focus only on tumor tissue and avoiding the ablation of healthy tissue. A solution might be a MR-compatible ultrasound probe which is able to follow the movement of the tumor over time, by tracking the diaphragm. Thereby making it possible to only ablate tumor tissue and spare healthy tissue, as well as reducing treatment time.

Avoiding ribs in MRgHIFU treated liver lesions

Groep 3; Eline Huizing, Bryan Wermelink, Kim van Noort, Carlijn Tenbergen

Abstract
Hepatocellular carcinoma is the most common liver tumor, and often secondary tumor nodules appear in the liver. Non-invasive treatment which can selectively destroy multiple nodules while leaving healthy liver tissue intact could be effective. MRgHIFU largely fits this description, but the ribs need to be avoided in order to gain access to the tumor lesions without the MRgHIFU causing burns on the skin and damage on the ribs. The main goal of our research is to review techniques in treating liver tumors with MRgHIFU while avoiding the ribs and to give a recommendation of which technique is the most promising in clinical use.

How can transarterial radioembolization particles be kept in place in a primary hepatocellular carcinoma, preventing lung shunting and only treat the tumor?

Groep 4; Lydia den Otter, Feiko Tiessens, Liza Hashemi, Daphne Huizing

Abstract
" Transarterial Radioembolization (TARE) treatment is a method to treat patients with unresectable hepatocellular carcinoma (HCC). Because of arteriovenous shunting, radioactive particles could cause irradiation of the lungs. Therefore the main purpose of this article was to find solutions to prevent lungshunting. Particles could be connected to receptors on endothelial cells within the tumor. To really achieve this goal, further research is needed. Another possibility is better clotting of the particles, which causes embolization. Ultrasound could indicate cross-linkage where upon deformation of the particles causes clotting. Also specific surface properties could increase embolization, as well as magnetic particles in the future. Extending embolization through ultrasound shows the most promising outcome to prevent lungshunting. The combination of HIFU (High Intensity Focused Ultrasound), another way of HCC treatment, with embolization of TARE particles, which also uses ultrasound, could have an enormous effect on the treatment of HCC. Research in this field is required.
Key words: TARE, HCC, lungshunting, embolization, ultrasound, HIFU

A review of the current status and future prospects for the treatment of large HCC

Groep 5; Manon Tolhuisen, Tom Jansen, Simon Overeem

Abstract
Hepatocellular carcinoma (HCC) is the third cause of death in cancer patients. In the West, the prevalence of HCC is increasing. Protocol of treatment is determined following the BCLC staging system, based on child-plugh, stage, amount of nodules and size. Liver transplantation and partial hepatectomy are the most optimal treatments of HCC. Yet, due to donor shortage and patient complications, 80% of patients are not suitable for surgical treatment. The possibilities for non-surgical treatments are still increasing, but still 60-70% patients will receive palliative treatment. One of the reasons for excluding patients is the existence of more nodules over 3 cm or one nodule over 5 cm. Using available literature, this article explores the current status and developments for non-surgical treatments. Found are new improved RFA and TACE techniques and the use of new combinations of chemotherapy which will result in improved survival rates following further recommendations.

Thermal HCC Ablation located to major vessles

Groep 6; Marloes Jansen, Peter Pijpker, Niels Schurink, Ruben van Veen

Abstract
BACKGROUND: Hepatocellular carcinoma (HCC) is the sixth most prevalent cancer in the world and the incidence rates in the western countries are increasing. There are several treatments available for HCC. A commonly used technique is Radio Frequent Ablation (RFA). The successfulness of the procedure depends on several factors. One of these is the presence of major vessels in the direct environment of the carcinoma. The recurrence rates of RFA ablated HCC adjacent to large vessels are 6 times higher compared to those not situated near large vessels. To prevent incomplete ablation real time temperature mapping during RFA can be a solution. Literature describes several techniques to do so. This paper compares these techniques and gives recommendations for clinical use and further research.
METHODS: Different methods of temperature mapping, described by scientific papers, were considered. Some papers involved temperature mapping techniques who are already in use in the ablation process, other papers involved techniques currently used in other medical fields. The chosen favourable techniques for temperature mapping are; MRI, thermofibers, thermocouples and infrared. These techniques are compared to each other in order to find the best suitable technique.
RESULTS: MRI is a promising technique but breathing movement, the fat stored in the liver and the RFA probe cause a decrease in accuracy of the temperature measurements. Inserting the RFA probe can only be achieved using an open intervention MRI which limits the strength of the MRI and therefore the spatial and temporal resolution. Thermocouples are currently already

being used integrated within the RFA electrode. The major disadvantage is the electromagnetic interference which results in unreliable measurements. Thermofibers do not cause electromagnetic interference so give more sensitive results. However, thermofibers are only available as standalone system instead of integrated in the RFA electrode. This increases the risk of cell seeding during pulling back.
DISCUSSION: MRI is a promising technique but currently not sensitive enough to determine the exact temperature rise in the HCC lesions adjacent to vessels, due to the complicated location and movement of the liver. Resolving the current holdbacks will make MRI-thermometrie the method of choice. Currently the use of thermofibers is the most sensitive and clinical proven temperature mapping technique. However, pulling back these fibers risks tumor cell seeding. We recommend to integrate the fibers within in the RFA electrode to minimize the risk of seeding and get more sensitive temperature results.

Nonrigid Image Fusion and Motion Correction as an Improvement of Accuracy During Radiofrequency Ablation of Hepatocellular Carcinoma

Groep 7; Irene Jansma, Simeon Ruiter, Else van der Velden, Daan Visscher

Abstract
Nowadays patients with hepatocellular carcinoma (HCC) nodules, when falling in the right category with regard to the size and number of the nodules, can be treated with radiofrequency ablation (RFA). This treatment can be performed under ultrasonography (US), magnetic resonance imaging (MRI) or computed tomography (CT) guidance but faces difficulties during the different steps in the procedure. This complication is partly due to liver translation, rotation and deformation, which can be compensated by a combination of motion correction and image fusion. Motion correction with image-based motion modeling seems a promising technique to automatically correct and predict the liver motion during the respiratory cycle. Nonrigid registration in contrast to rigid registration is an image fusion technique which also takes into account liver deformation. A combination of two of these techniques may make it possible to improve the accuracy during RFA treatment.

Active needle tracking for use in real time interventional MRI for ablation of hepatocelullar carcinoma

Groep 8; Roel Verhoeven, Kayleigh Dukker, Guido de Jong, Anke Schoutrop

Abstract
Hepatocellular carcinoma ablation is increasingly often performed percutaneously. Lack of information on needle position herein severely impairs ablation accuracy. To accurately perform these interventions and to avoid complications, real time needle position is desired. In this article, a novel method for gaining insight in real time needle position with use of active needle tracking in MRI is described. A review upon current developments and the key components is presented.

MR-Thermometry as a correction for respiratory motion during HCC treatment with HIFU

Groep 9; Kilian Kappert, Femke Schröder, Bas de Vries

Abstract
Respiratory motion during surgery can give a lot of complications, like healthy tissue damage or retaining undesirable unhealthy tissue. To overcome the problem of respiratory motion during High-intensity focused ultrasound (HIFU) therapy, a good non-invasive respiratory motion correction method is desired. In this case report the focus is on MR thermometry, to find out if MR thermometry can be used as a precise correction method for breathing motion during HIFU treatment of a HCC (hepatocellular carcinoma).

Real-Time Damage Monitoring for Percutaneous treatment of liver tumors

Groep 10; Klaske Siegersma, Judith Olde Heuvel, Gijs Luijten

Many percutaneous methods are developed to treat hepatocellular carcinoma (HCC). A part of these methods works with thermal ablation to destroy the tumor cells. To avoid unwanted ablation of healthy tissue, it is important to monitor temperature during treatment. The objective of this paper is to give an overview of three selected methods, namely T1 thermometry, Proton Resonance Frequency Shift, Di_usion Weighted Imaging, for real-time temperature monitoring with the help of magnetic resonance. The pro's and con's will be discussed together with the shortcomings of the methods available. At last possible enhancements are given to improve real-time temperature monitoring and make it available for the clinic.