S-S01

Ultrasound Intra-needle Probe for Thoracic Regional Anesthesia - PVB Insertion and Guiding Applications

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Ultrasound has been widely used for guiding the insertion of needles close to nerve locations in regional anesthesia. Regional anesthesia has gained a lot of popularity in clinics due to many advantages over general anesthesia, including faster recovery, better postoperative pain control, shorter hospital stay, and less adverse effect with non-opioid drugs. Paravertebral block (PVB) has been widely used and is effective for providing pain relief in thoracic regional anesthesia.

Unmet needs: During ultrasound-guided PVB approach, it is very difficult to accurately identify the positioning of the needle tip, especially for high body mass index (BMI) patients, and may result in complications and failure in the anesthesia. We have developed an innovative intra-needle ultrasound (INUS) transducer and validated its efficacy in identifying pleura position in thoracic region anesthesia, in in-vivo studies. The INUS transducer is custom designed, 20 MHz, PMN-PT crystal, 40% bandwidth, and can be fitted into a regular 18G needle. The axial resolution of the transducer is 0.15 mm.

We have evaluated the INUS device for PVB punctures in 10 piglets, and the PVB successes have been confirmed by dye spreading and dissection. We have observed the double-layered pleura structure, parietal pleura and visceral pleura. The visceral pleura has specific flickering characteristics, and can be used as a landmark for guiding the needle insertion towards the PVB space. The innovative INUS device allows real-time identification and tracking of the visceral pleura, and can facilitate successful PVB procedures.

Ultrasound Single-Phase CBE Imaging for Monitoring Radiofrequency Ablation of the Liver Tumor: A Preliminary Clinical Validation

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Radiofrequency ablation (RFA) is an alternative treatment for early-stage hepatocellular carcinoma (HCC). The production of gas bubbles by RFA indicates threshold temperature of tissue necrosis and results in changes in backscattered energy (CBE) when ultrasound monitors RFA. In this study, ultrasound single-phase CBE imaging was used as a means of monitoring RFA of the liver tumor by analyzing the backscattering of ultrasound from gas bubbles in the liver. A total of 19 HCC patients were enrolled in the study. An ultrasound system was used during RFA to monitor the ablation process and acquire raw image data consisting of backscattered signals for single-phase CBE imaging. On the basis of single-phase CBE imaging, the area corresponding to the range of gas bubbles was compared with the tumor sizes and ablation zones estimated from computed tomography. During RFA, ultrasound single-phase CBE imaging enabled improved visualization of gas bubbles. Measured gas bubble areas by CBE were related to tumor size (the Spearman correlation coefficient $rs = 0.86$; $p<0.05$); less dependent on the ablation zone. Approximately 95% of the data fell within the limits of agreement in Bland-Altman plots, and 58% of the data fell within the 95% CI. This study suggests that single-phase CBE imaging provides information about liver tumor size because of the abundant vessels in liver tumors that promote the generation of gas bubbles, which serve as natural contrast agents in RFAs to enhance ultrasound backscattering. Ultrasound single-phase CBE imaging may allow clinicians to determine if the required minimum RFA efficacy level is reached by assessing gas bubbles in the liver tumors.

S-S02

S-S03

Quantitative Analysis of Quality Assurance for Ultrasound-guided High Intensity Focused Ultrasound Using Micro-CT

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HIFU is a non-invasive ablation treatment defined as a surgical resection with precise thermal ablation. Good focusing performance is required to ensure a small focus area and high energy.

In clinical practice, ultrasound-guided HIFU completely relies on real-time ultrasonic imaginges to assess the cavity area and treatment range. The position and size of each ablation can only be seen on the image after tissue damage is caused. For HIFU, the most important aspect at present is the stability of the output dose and control of its focal position.

In this study, we used a bullet-type rubber target for quality assurance provided by the manufacturer, and followed the quality assurance procedures after monthly maintenance, as suggested by the manufacturer.

This study tries to use micro-CT to measure the real damaged area on the target and quantify the output quality of the HIFU instruments (Model JC Focused Ultrasound, Chongqing Haifu).

S-S04

HIFU for Parkinson Disease

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Since the FDA approved the MRgFUS technology for ET and TDPD, MRgFUS offers feasible results in non-incisional surgery and optimizes accuracy in targeting. Here I would like to share our very preliminary results of MRGFUS in the treatment of movement disorders mainly on Parkinsonism.

Since June 2017 to Mar. 2021, we screened 648 patients with movement disorders. There were 440 patients with ET, 156 with PD and 52 with other than ET or PD. There were 10 (6.4%) patients with TDPD. Sixty eight (15%) patients with ET and 16 patients with PD (VIM for TDPD 6/16, PTT for PD 10/16) were received MRgFUS ablation surgery.

This is the first experience in Taiwan in the treatment of PD with MRgFUS. Our experiences demonstrate the feasibility, safety, and accuracy of the MRgFUS. AEs are related to high edema grades of ablated lesions. Surgeons should take great care in each sonication especially with high power and long periods in high energies delivery. In the treatment of Parkinson disease, the technique of MRgFUS may be an alternative choice for patients instead of DBS, GKRS and RF

Abbrev.

HIFU: high intensity focused ultrasound
ET: essential tremor
TDPD: tremor dominant Parkinson disease
MRgFUS: MRI guided focused ultrasound
VIM: nucleus ventral intermediate
PTT: pallidothalamic tract
AE: adverse effect
DBS: deep brain stimulation
GKRS: Gamma knife radiosurgery
RF: radio frequency

S-S05

HIFU for Cosmetic Application

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1. High-intensity focused ultrasound (HIFU)

   HIFU can generate high time-averaged intensity at the focal point to cause tissue damage. For example, the time-averaged intensity of ultrasound for diagnostic medicine is about 0.1-100mW/cm2, and the wave's pressure is between 0.001-0.003MPa. However, the intensity of the focal area of HIFU can reach 100-10000W/cm2, and the pressure is between

10-30MPa.

After the tissue absorbs the intensity of HIFU, it can be converted into heat energy so that the area temperature can reach above 60 degrees Celsius to cause coagulative necrosis within seconds.

In addition to thermal effects, HIFU can also cause mechanical phenomena, such as cavitation, microstreaming, and radiation forces. Clinical uses of HIFU include the treatment of benign or malignant tumors, such as liver cancer, pancreatic cancer, prostate cancer, renal cell carcinoma, bladder cancer, and sarcoma. In addition, HIFU can treat thrombolysis, hemostasis, drug and gene delivery.

2. HIFU for Cosmetic Medicine

HIFU instrument used in cosmetic medicine only applies the thermal effect (greater than 60 degrees Celsius).

According to the purpose of action, we can divide it into these categories:

(1) For the destruction of adipose tissue (HIFU)

(2) For lifting effect of skin (microfocused ultrasound, MFU)

(3) Under research: In addition to the above applications, various dermatology and aesthetic medicine indications have been under research in recent years. They include pigmentary diseases, tattoo removal, and facial pores. Besides, HIFU can treat skin tumors in dermatology, such as lipoma, precancerous actinic keratoses, and malignancy (basal cell carcinoma and Kaposi's sarcoma) .

3. Effects and Risks of HIFU in Aesthetic Medicine

HIFU can cause significant damage to soft tissue. Therefore, safety is a primary concern in the application of aesthetic medicine.

The consideration of safety should be greater than the consideration of efficacy. We should be aware of its risks, such as skin burns, nerve damage, eye damage, and possible long-term injuries to the superficial musculoaponeurotic system (SMAS).

S-S06

Routine Use of HIFU for the Treatment of Prostate Cancer

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I have performed edap Albatherm HIFU for the treatment of localized prostate cancer since 2009. More than 600 patients have been treated. In comparison with radical prostatectomy, brachytherapy and cryotherapy, we have shown the oncological outcomes of HIFU are not inferior to those of other treatments. However, the complications such as incontinence and erectile dysfunction are much less than other treatments.

Sonablate HIFU for the treatment of prostate cancer has also been introduced since 2021. More than 60 patients have been treated at Jhong Siao hospital. In comparison with the previous Albatherm HIFU, it has the feedback sensor for the treated area. It is more delicate and precise, but is more time-comsuming. The oncological control for the low and intermediate risk patients are excellent. Besides, HIFU with salvage radiotherapy can also rescue the cancer control for the high risk patients.

As further long term follow up data mature, we anticipate broader acceptance of HIFU and routine application in the near future.

Other-P01

Rapid Growing Case of Type 2 Madelung Disease: Case Report and Literature Review

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Backgrounds: Madelung disease, also called as Benign Symmetric Lipomatosis (BSL). It was first reported by Brodie in 1846. In 1888, Madelung first analyzed 33 cases series. Abstinence of alcohol cannot completely prevent post -operative recurrence. Mitochondrial gene alteration is the basis pathogenesis.

Material and Methods: A Madelung disease with rapid growing back mass was described. PubMed, Google scholar were searched with the terms of Madelung's disease, Benign Symmetric Lipomatosis, and type. Clinical characteristics were reviewed.

Results: A 68-male patient with rapid growing back mass in 2 weeks visited nephrology OPD of Taipei City Hospital, Zhongxiao campus. There was personal history of long- term alcohol drinking. He was referred to GS OPD for surgery for fear of malignancy. He has comorbidity, such as alcoholic related liver disease, albuminuria, brainstem stroke with bulbar signs, gout, GERD, GU, ulcer of ileocecal valve, hyperplastic polyp of colon, hyperlipidemia and hypertension. Further examination included ultrasound of the back mass (Figure 1) and contrast enhanced CT(Figure2). Excision of upper back mass was done on 2020-9-7. Renal ultrasound showed bilateral renal stones. The detailed descriptions of ultrasound of the back mass revealed longitudinal view: a subcutaneous hypo-vascular mass with internal echoes with heterogeneity echotexture sized 8.3 * 2.7 cm in connection with skin, transverse view: a subcutaneous hypo-vascular mass with internal echoes with heterogeneity echotexture sized 7.1 * 2.5 cm in connection with skin, oblique view: maximal depth 3.6cm. Hypothyroidism and Cushing syndrome were ruled out by hormone study. The pathological report revealed benign lipomatosis (Figure 3). He was discharged eventfully. The disease is highly prevalent in the Mediterranean region and east Europe, which is more common in middle-aged men. Madelung disease characterized by slowly progressive symmetrical deposition of adipose tissue in the subcutaneous superficial and/or deep fascial spaces of the neck (type 1), back and shoulder type (type 2) and pelvic girdle (type 3). Patients with type 1 Madelung disease often presented with neck deformity, limited mobility, and compression of the trachea, difficulty breathing and seek medical attention. The main treatment method is complete surgical excision, but alternative treatment is liposuction. Hyperplastic fat is completely removed along the cervical fascia to avoid recurrence. Madelung disease is closely associated with long-term heavy alcohol intake (3-6 bottle beer once /week in our case or and long history of alcoholism because alcohol can hinder adrenergic receptor driven lipolysis.

Conclusion: The presentations of patients with Madelung disease are related to locations of lipomatosis. Comorbidity are mostly related to alcohol drinking and mitochondrial gene alterations. Post -operation recurrence is common. Malignant transformation is rare.