Interventional Oncology Series: Lung and Bone

Participants
Moderator: Matthew Raymond Callstrom, MD, PhD
- Research Grant, Theromedical, Inc
- Research Grant, General Electric Company
- Research Grant, Siemens AG
- Research Grant, Galil Medical Ltd

Sub-Events

MW vs RFA vs Cryo for Lung Mass Ablation—Which/When/Where?
Damian E. Dupuy MD (Presenter):
- Research Grant, NeuWave Medical Inc
- Board of Directors, BSD Medical Corporation
- Stockholder, BSD Medical Corporation
- Speaker, Educational Symposia

LEARNING OBJECTIVES
1) Understand differences between the various thermal technologies as applied to lung tumors.
2) Review current clinical thermal ablation data with regard to the treatment of lung tumors.
3) Comprehend the usage of the various thermal modalities with clinical examples of lung tumor treatment.

Latest Advances in Lung Surgery for Metastatic Disease
Francis C. Nichols MD (Presenter):
- Nothing to Disclose

LEARNING OBJECTIVES
1) Identify appropriate patients who are felt to benefit from pulmonary metastasectomy.
2) Discuss the pros and cons of pulmonary metastasectomy done via a traditional open thoracotomy versus minimally invasive Video-Assisted Thoracic Surgery (VATS).
3) Describe a localization technique for the small difficult to locate pulmonary metastasis(es).
4) Discuss the rationale for mediastinal lymphadenectomy during pulmonary metastasectomy and its prognostic implications.

Quantitative Validation of Thermal Ablation: An Improved Image Fusion Algorithm to Reflect Treatment Coverage
David Thomas Glidden BS (Presenter):
- Nothing to Disclose
Grayson L. Baird MS:
- Nothing to Disclose
Damian E. Dupuy MD:
- Research Grant, NeuWave Medical Inc
- Board of Directors, BSD Medical Corporation
- Stockholder, BSD Medical Corporation
Derek Merck:
- Nothing to Disclose

PURPOSE
To propose the foundation of a quantitative method for validation of thermal ablations.

METHOD AND MATERIALS
24 patients (M:F= 10:14) with solitary lung tumors underwent microwave ablation under CT-guidance. Each tumor was treated with one of four MW applicators (BSD Medical, Salt Lake City, UT, Neuwave Medical, Madison, WI) for 5-15 minutes according to the manufacturers’ specifications. Each case included a CT scan pre- intra- and post-procedure. Tumor volumes were manually segmented from pre-scans and ablation volumes from post-scans using the ground glass halo surrounding the tumor. Pre-scans were fused onto post-scans using two algorithms—a rigid registration, and a rigid plus deformable registration. Volume overlap resulting from both algorithms were calculated. Bland-Altman plots and Deming regression were used to identify possible differences in these image fusion techniques.

RESULTS
The volume overlap between tumors and ablation zones increased proportional to tumor size when deformable registration was applied (p < 0.001). Deming regression showed a significant deviation from perfect concordance between rigid and deformable registration (95% CI: [1.13, 1.39]) in which more volume overlap was attributable to deformable registration.

CONCLUSION
Quantitative validation of thermal ablation margin analysis remains challenging due to inherent tumor position and morphology changes after ablation. Rigid registration techniques rarely reflect how an ablation zone covers the tumor and margin because of movement (e.g. respiratory, tumor displacement, patient position). The addition of deformable registration may more accurately reflect how the tumor and ablation zone overlap, thus improving local control outcomes.

CLINICAL RELEVANCE/APPLICATION
Improved fusion between pre- and post-scans using deformable registration will provide a basis for
clinical relevance and application. Primary and metastatic lung tumors are extremely common; surgical options are often limited due to advanced disease and/or poor respiratory function. Microwave ablation offers a robust method of local disease control.

LEARNING OBJECTIVES

1) Review definitions of SBRT. 2) Discuss results of SBRT for pulmonary nodules. 3) Review current and proposed clinical trials for pulmonary nodules. 4) Review currently accepted indications for SBRT.

ABSTRACT

Stereotactic Body Radiotherapy (SBRT), also known as Stereotactic Ablative Radiotherapy (SABR), has become an important new tool for oncologists looking to treat patients with primary lung cancers or pulmonary metastases. In this talk we will discuss some of the fundamentals of SBRT, review relevant literature, and current indications of SBRT for either primary lung cancers or metastases.

VSI05-06

Ablation for Primary Lung Cancer What does the Data Support

Robert D. Suh MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES

1) Discuss long term outcomes of image-guided ablation for early stage lung cancer. 2) Discuss local control rates of image-guided ablation for early stage lung cancer. 3) Understand the factors in image-guided ablation influencing survival and local control. 4) Understand treatment options and relative outcomes of image-guided ablation compared to alternative therapies for early stage lung cancer.

ABSTRACT

Although the literature on thermal ablation demonstrates heterogeneous, sometimes markedly so, reporting, thermal ablation confers increasingly improved local control and survival benefits in carefully selected patients: RF ablation with long-term results comparable to competitive therapies, particularly in the high-risk patient population. Despite advances in thermal energy devices, specifically microwave and cryoablation, delivery and combination therapy leading to improved local control, gains in survival will be limited for this high-risk population, given the limitations of radiographic staging and presence of already microscopic lymph nodal and distant disease at the time of image-guided ablation, a risk inherently present with all local therapies. Thus far, thermal ablation remains a safe therapeutic and effective option to treat 1° lung malignancies.
Non-thermal Irreversible Electroporation (NTIRE) Fails to Demonstrate Efficacy on Lung Malignancies in a Prospective Multicenter Phase II Trial


Purpose
To assess safety and efficacy of non-thermal irreversible electroporation (IRE) of lung malignancies.

Method and Materials
Patients with primary and secondary lung malignancies and preserved lung function were included in this prospective single arm trial. Primary and secondary endpoints were safety and efficacy. Recruitment goal was 36 subjects in 2 centers. Patients underwent IRE under general anesthesia with probe placement performed in Fluoroscopy-CT. The IRE system employed was NanoKnife® (Angiodynamics). System settings for the ablation procedure followed the manufacturer’s recommendations. The Mann-Whitney-U-test was used to evaluate the correlation of 9 technical parameters with local tumor control. Median follow up was 12 months.

Results
The expected efficacy was not met at interim analysis and the trial was stopped prematurely after inclusion of 23 patients (13/10 between both centers). The dominant tumor entity was colorectal (n=13). The median tumor diameter was 16mm (8-27mm). Pneumothoraces were observed in 11 of 23 patients with chest tubes required in 8 (35%). Frequently observed alveolar hemorrhage never led to significant hemoptysis. 14/23 showed progressive disease (61%). Complete remission was found in 7 (30%). The relative increase of the current during ablation was significantly higher in the group treated successfully as compared to the group presenting local recurrence (p<0.05).

Conclusion
NTIRE is not effective for the treatment of lung malignancies. We hypothesize that the energy deposition with current IRE probes is highly sensitive to air exposure.

Clinical Relevance/Application
NTIRE is not effective for the treatment of lung malignancies.

Ablation for Metastatic Lung Cancer Is Ablation Competitive with Surgery or SBRT?

Thierry Debaere (Presenter): Consultant, Terumo Corporation Speaker, Terumo Corporation Consultant, Guerbet SA Consultant, General Electric Company Consultant, General Electric Company Proctor, Galil Medical Ltd

Learning Objectives
1) To know results of percutaneous ablation of lung metastases in terms of local efficacy and survival.
2) To know predictive factors of RFA for lung metastases.
3) To know results of surgery and stereotactic radiation therapy for lung metastases.

Abstract
Since first report of RFA in lung tumor in year 2000, RFA has been demonstrated to provide 80 to 90% complete ablation for tumors less than 2 cm, with decrease in efficacy for larger tumors. Percutaneous ablation is today a valid option for lung metastases in non surgical candidates with overall survival reported after RFA is in between 56 to 67% at 3 years. Such survival reported is comparable to what reported in large surgical series even if no comparative data exists. Age, disease free interval, tumor size and tumor numbers are independent predictor of survival after RFA of lung metastases. The same predictive factors have been reported as predictive of survival after surgical metastasectomy. One of the advantage of RFA over other technique such as surgery and SBRT is that it can be easily repeated in case of occurrence of new metastases which is difficult with surgery due to the aggressively of the procedure. Subsequent surgical resection are limited by pulmonary reserve. The same applies to stereotactic radiation therapy where multiple irradiation results in toxicity to lung parenchyma, skin or mediastinum. Consequently, RFA is today part of routine practice armentarium against lung metastases. However, better determination of the role of RFA relative to other therapies are needed. In addition, the need and benefit from combining local ablation and systemic therapy must be evaluated. Future trends in treatment of pulmonary metastases will favor minimal aggressive treatments and percutaneous ablation have a role to play. Evidence based medicine supporting the use of lung RFA metastatic disease and defining what is the best population to target with ablation or SBRT. For today the ideal candidate has less than 3 tumors less than 3 cm.

Lung Tumor Board

Moderator Matthew Raymond Callstrom MD, PhD: Research Grant, Thermedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Galil Medical Ltd

Learning Objectives
1) Describe the characteristics of lung and bone tumors amenable to interventional oncologic treatment.
2) Describe new techniques for the percutaneous treatment of lung tumors and bone metastases.
3) Describe the role of percutaneous ablation for lung tumors and bone metastases in the context of other treatments including surgery and radiation oncology.

Treatment of Complex Benign Skeletal Disease

Afshin Gangi MD, PhD (Presenter): Proctor, Galil Medical Ltd

Learning Objectives
1) Identify the best indications of percutaneous technique and list them. 2) Describe the methods used in treatment of benign skeletal tumors and the advantages and limits of each of them. 3) Identify the risks of the percutaneous procedures and their limits. 4) Explain the measures used to protect the surrounding tissues to avoid major complications. 5) Learn how to follow up the patients and analyze the results.

VSI051-11  
Pain Palliation of Bone Metastases and Local Tumor Control with Magnetic Resonance Guided Focused Ultrasound Surgery (MRgFUS) Treatment

Alessandro Napoli MD (Presenter): Nothing to Disclose, Brachetti Giulia MD: Nothing to Disclose, Valeria De Socco: Nothing to Disclose, Fabrizio Andrani: Nothing to Disclose, Gianluca Caliolo: Nothing to Disclose, Fulvio Zaccagna MD: Nothing to Disclose

PURPOSE

to evaluate the efficacy of MRgFUS for treatment of painful bone metastases and its potential for local tumor control.

METHOD AND MATERIALS

after IRB approval 42 patients were scheduled for treatment using the Exablate system (InSightec). Before and 1, 2 and 3 months after MRgFUS treatment, pain scores were assessed according to Brief Pain Inventory-Quality of Life (BPI-QoL) criteria. Imaging (CT and ceMR: Bracco) follow-up was obtained at 1 and 3 months; in survivals, follow-up was extended at 6 and 12 months. For local tumor control, imaging changes were evaluated with the MD Anderson (MDA) criteria. Patients were classified in responder and non-responders. The extent of necrosis within the ablated metastasis was evaluated using non-perfused volume (NPV).

RESULTS

All 42 patients underwent MRgFUS (20 recurrence post-RT; 22 primary treatment). Statistically significant difference between baseline and follow-up values for both pain severity and pain interference scores was observed (p

CONCLUSION

MRgFUS is an effective and durable treatment for pain palliation of bone metastasis; moreover, a positive role in local tumor control and bone restoration was demonstrated.

CLINICAL RELEVANCE/APPLICATION

MRgFUS can be safely and effectively used as treatment for pain palliation of bone metastasis in patients who had exhausted EBRT and also in patients not previously treated with EBRT. The treatment creates bone metastasis necrosis and so might have a positive role in local tumor control and bone restoration. The major advantages of the technique include its non-invasive nature. The treatment can be performed in a single session, does not use ionizing radiation and utilizes MR guidance for precise targeting and thermal control.

VSI051-12  
Radiofrequency Ablation of Spinal Disease

Jack William Jennings MD (Presenter): Speakers Bureau, DFINE, Inc Consultant, DFINE, Inc

LEARNING OBJECTIVES

1) Metastatic spine overview 2) Patient selection and treatment evaluation 3) Current guidelines for treatment of metastatic spine lesions 4) Imaging of lesions 5) Role of vertebral augmentation in metastatic disease 6) Targeted Radiofrequency ablation (RFA) 7) RFA and radiotherapy (RT) 8) Multi-disciplinary treatment algorithm

ABSTRACT

Bone metastases are a major cause of morbidity in patients with cancer and represent a common occurrence in these patients. The vertebral column is the most common site for bone metastases with an incidence of 30-70% in patients with metastatic cancer and is likely related to the high hematopoietic activity and vascularization of the spine. Management of these patients is challenging and traditionally involves a combination of radiation and chemotherapy in adjunct with analgesics. Surgery has remained a mainstay of treatment in patients with neurologic deficit, instability requiring stabilization, or with a longer life expectancy. Surgical options in these patients with decreased life expectancy are often morbid and present a therapeutic dilemma. Minimally invasive procedures, including thermal ablation, are safe and effective treatments of painful osseous metastatic lesions in patients who are not surgical candidates or have exhausted or are unable to have radiation therapy. Radiofrequency ablation (RFA) has been increasingly utilized in management of osseous metastases. In the spine, this treatment has traditionally been limited to lesions within the anterior vertebral body since this location is more accessible and further away from sensitive neural elements. Many spinal tumors will continue to grow and cause pain after radiation therapy. Posterior vertebral body lesions will often progress and extend through the posterior cortex into the spinal canal making therapeutic options very limited. The development of an articulating bipolar electrode has allowed for targeted RFA and the ability to treat posterior spinal lesions via a transpedicular approach. Review of the existing literature and current treatment guidelines demonstrates the need for future prospective studies of spine tumor ablation and for the development of a treatment algorithm defining its role with the current accepted treatment options.

VSI051-13  
Sequential Interventional Treatment of Pelvic/Sacral Tumors via Angiographic Embolization, Cryoablation, and Stabilization Plasty Combinational Therapy


PURPOSE

The purpose of the study is to review the treatment experiences of patients treated at our institution with combination angiographic embolization, cryoablation or thermal ablation, and stabilization plasty for their pelvic/sacral tumor burden. This study hopes to assess if such combinational interventional therapy has the potential to become a mainstay treatment option in managing pelvic and sacral neoplasms.
METHOD AND MATERIALS
A combined interventional paradigm was employed in 8 patients thus far over the last year: Phase I: Angiographic embolization of neoplasm Phase II: Cryoablation of solid tumor, followed by supportive sacroplasty Phase III: Image-guided drainage/TPA flush, followed by sclerosis of residual bed Procedures were performed under general anesthesia. Phase I was within 1 day to 1-2 weeks prior to Phase II and III dependent on lesion location and patient tolerance. Neurological monitoring was utilized in Phases 2 and 3 to assess integrity of sacral nerve function during procedures. Each patient underwent pretreatment CT and/or MRI examination prior to therapy. All patients have undergone post-therapy follow-up imaging within 1-3 months. Medical records and imaging portfolios for these patients will be reviewed. A reassessment of pre and post procedure lesion measurements and quality of life outcomes will be performed. Linear regression will be performed to correlate results of imaging and quality of life assessment.

RESULTS
It is hypothesized that patients undergoing sequential combinational therapy will demonstrate significant decrease in lesion growth, as well as improved pain control and quality of life. It is unclear if survival will be affected by such measures, as patients with terminal disease pursued such procedures more so for symptomatic relief.

CONCLUSION
An interventional paradigm consisting of combinational implementation of angiography-mediated embolization, thermal/radiofrequency ablation, and mechanical drainage followed by cavity sclerosis is expected to become a mainstay treatment option of pelvic and sacral neoplasms. The results of our review is expected to provide insight into its use in patients needing physical and symptomatic reduction of their pelvic/sacral tumor burden.

CLINICAL RELEVANCE/APPLICATION
Sequential incorporation of several effective interventional treatments may play a role in the treatment paradigm of pelvic and sacral neoplasms.

VSI051-14
Avoiding Complications with Bone and Soft Tissue Ablation
Anil Nicholas Kurup MD (Presenter): Nothing to Disclose

LEARNING OBJECTIVES
1) Identify critical anatomic structures to be avoided during bone and soft tissue tumor ablation. 2) Apply risk of collateral damage during bone and soft tissue ablation. 3) Understand radiographic and neurophysiologic monitoring techniques that may be employed during bone and soft tissue ablation. 4) Recognize the role of bone consolidation as an adjunct to bone ablation.

VSI051-15
Treatment of Oligometastatic Disease: What Is the Role of Ablation?
Peter John Littrup MD (Presenter): Founder, CryoMedix, LLC Research Grant, Galil Medical Ltd Research Grant, Endo Health Solutions Inc Officer, Delphinus Medical Technologies, Inc

LEARNING OBJECTIVES
1) Understand how ablation of limited, or oligo-, metastases could produce a major impact on numerous cancer types. 2) Describe the major anatomic locations that are considered common oligometastatic sites. 3) Describe the outcomes for procedure complication and recurrence rates for the major anatomic sites. 4) Describe the potential economic impacts of ablation as part of palliative care for major cancer types (e.g., renal, lung, colorectal, ovarian).

VSI051-16
Preoperative Embolization in Surgical Treatment of Spinal Metastases: Single-Blind, Randomized Controlled Clinical Trial of Efficacy in Decreasing Intraoperative Blood Loss
Caroline Clausen MD (Presenter): Nothing to Disclose, Lars Lonn MD, PhD: Nothing to Disclose, Benny Dahl MD, PhD: Nothing to Disclose, Michael Bachmann Nielsen MD, PhD: Nothing to Disclose, Susanne Christiansen Frevert MD: Nothing to Disclose

PURPOSE
To assess whether preoperative embolization reduces intraoperative blood loss, the need for blood transfusion, and operative time in the surgical treatment of symptomatic metastatic spinal cord compression.

METHOD AND MATERIALS
A single-blind, randomized (balanced 1:1), controlled, parallel-group trial conducted as a single-center study; 48 participants were included from May 2011 until March 2013. Participants scheduled for decompression and posterior thoracic/lumbar instrumented spinal instrumentation because of symptomatic metastatic spinal cord compression were randomly assigned to either preoperative arteriography and embolization - the intervention group or preoperative arteriography - the control group. Primary outcome: intraoperative blood loss. Secondary outcomes: Intra- plus postoperative blood loss, blood transfusion and duration of surgery. Outcomes were reported as intention-to-treat analyses (ITT) including all randomized patients with a standing consent to participate and meeting the inclusion criteria.

RESULTS
Of the 48 randomized patients, 45 (23:22) were available for the ITT after exclusion of patients violating inclusion criteria. Mean intraoperative blood loss did not differ significantly between the embolization group (618 ml; SD 282 ml) and the control group (735 ml; SD 415 ml). This was also the case for intra- plus postoperative blood loss and the need for blood transfusion. The duration of surgery was shorter in the embolization group compared to the control group (p=0.031); median 90
CONCLUSION

Preoperative embolization does not result in a reduction of intraoperative blood loss and blood transfusion, but reduces the duration of surgery. The general routine use of preoperative embolization cannot be recommended in decompression and posterior instrumented spinal instrumentation for symptomatic metastatic spinal cord compression.

CLINICAL RELEVANCE/APPLICATION

This randomized controlled clinical trial displays that preoperative embolization has the advantage of reducing the duration of surgery for symptomatic metastatic spinal cord compression.

Bone Metastases Tumor Board

Moderator Matthew Raymond Callstrom MD, PhD: Research Grant, Thermedical, Inc Research Grant, General Electric Company Research Grant, Siemens AG Research Grant, Galil Medical Ltd

LEARNING OBJECTIVES

1) Describe the characteristics of lung and bone tumors amenable to interventional oncologic treatment. 2) Describe new techniques for the percutaneous treatment of lung tumors and bone metastases in the context of other treatments including surgery and radiation oncology.