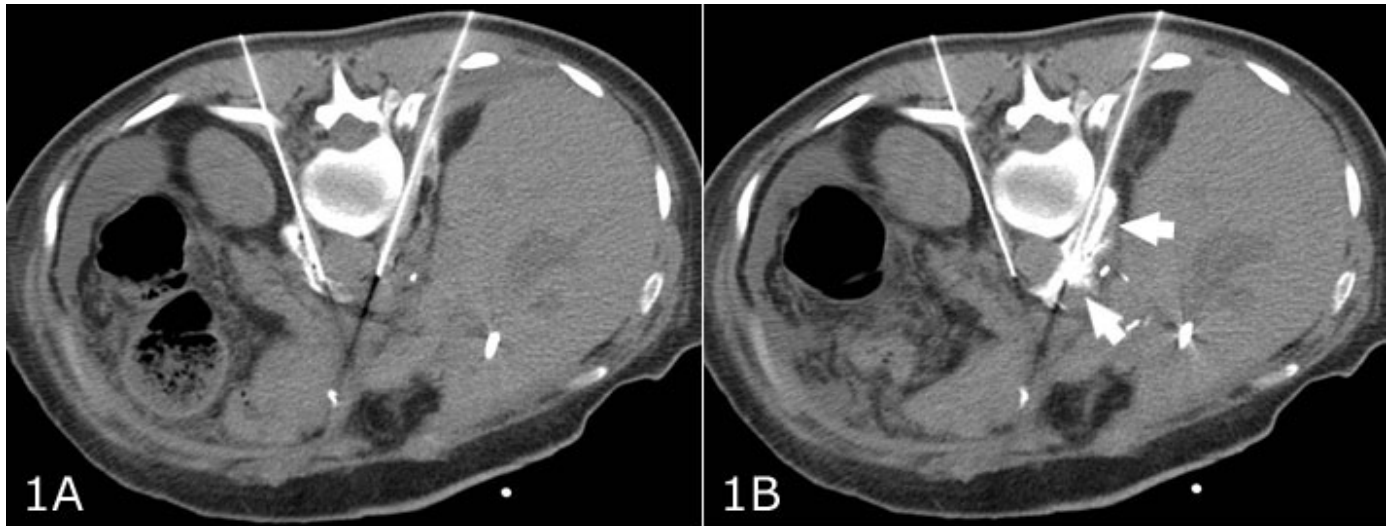




## Palliative Interventional Radiology, Part I: Image-Guided Techniques for Pain Relief

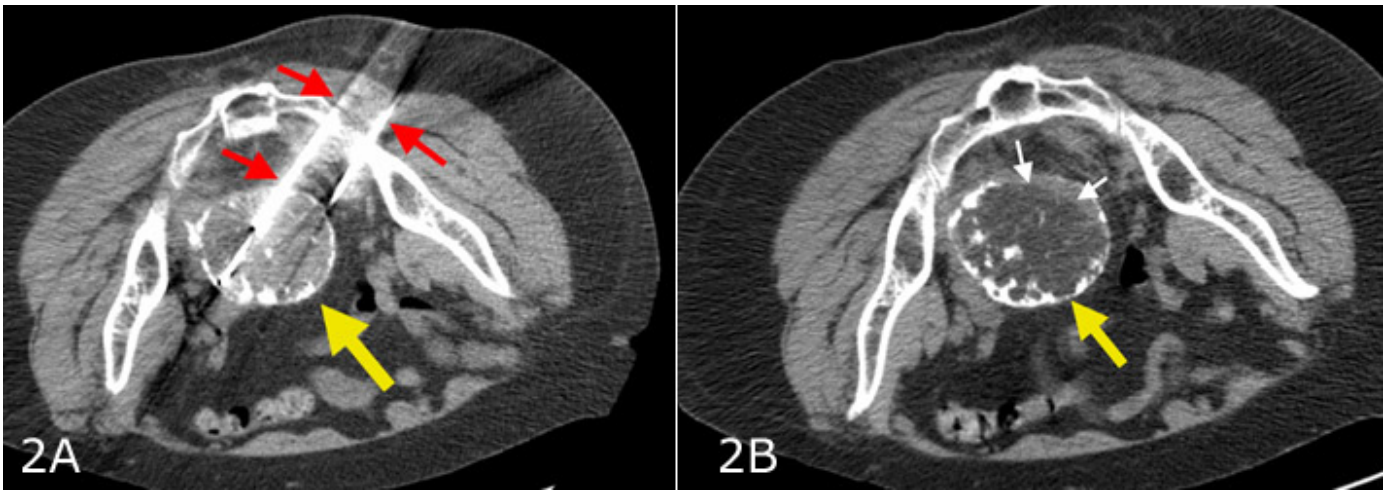
- Neurolysis of the celiac plexus or superior hypogastric plexus can provide pain relief emanating from upper abdominal and pelvic organs, respectively, allowing reduction in opioid medications and their side effects
- Thermal ablation (radiofrequency or cryoablation) is an effective treatment for painful soft tissue metastases and bone metastases
- Percutaneous injection of polymethylmethacrylate (PMMA) is used to treat painful bone metastases and vertebral body compression fractures



**Figure 1.** Celiac Plexus Neurolysis. **(A)** CT image shows placement of two needles into the antero-crural spaces 1-2 cm anterior to aorta at the level of celiac artery. **(B)** Shows distribution of injected alcohol and contrast material (arrows).

Interventional radiologists offer many palliative treatments to alleviate pain and suffering. These include image-guided ablative treatments to control pain, oncological palliation to reduce tumor burden, tube insertion for nutritional support, and various drainage and diversion procedures. Before any of these procedures are performed, it is essential to consider some ethical principles and to recognize that the patient is the final arbiter in any decision. The intervention should be for the net good and benefit the patient; technical success is not a sufficient end point. The decision to perform any of these procedures should be taken by a multi-disciplinary team that includes surgeons, oncologists, palliative specialists, and interventional radiologists, as well as the patient and the patient's family.

In the first article of this three-part series we describe some image-guided techniques for pain relief. Part 2, to be published in February will discuss nutritional support and other comfort measures. Part 3, to be published in March, will discuss tumor palliation.



**Figure 2. Thermal Ablation of Painful Bony Metastases. A)** CT image shows cryo-ablation of metastatic chondrosarcoma (yellow arrow) in the sacrum using a 15cm and 23 cm probe (red arrows). Four contiguous burns were performed. **(B)** Axial CT image post cryoablation shows the ice ball growing (seen as diffuse hypodensity, white arrows) within the tumor (yellow arrow) allowing visualization of the margins of tumor destruction.

## Neurolysis

Neurolysis is a procedure in which ethanol (or phenol) is injected under image guidance to ablate nerves and thus block pain. Celiac plexus neurolysis is effective in alleviating pain arising from the visceral structures of the upper abdomen. Superior hypogastric plexus neurolysis alleviates pain arising from pelvic malignancies. Neither is effective in relieving somatic pain. Neurolysis is recommended for persistent and intractable pain that is not sufficiently alleviated with opioids or when the side effects from these drugs are intolerable. Neurolysis is contraindicated in patients with severe, uncorrectable coagulopathy or thrombocytopenia. Celiac plexus neurolysis may be contraindicated in patients with an abdominal aortic aneurysm because of the proximity of the celiac plexus. Local and intra-abdominal sepsis are also contraindications.

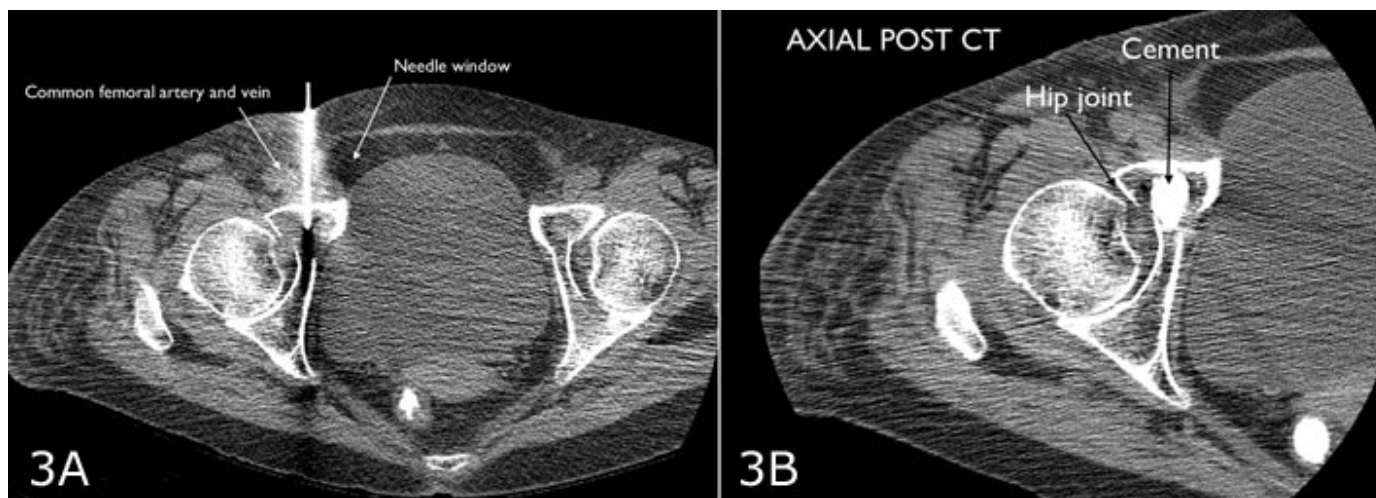
Neurolysis is performed under conscious sedation and with local anesthesia. In celiac plexus neurolysis, needles are placed in the right and left anterocrural or retrocrural space under CT guidance (Figure 1). In superior hypogastric plexus neurolysis, a needle is placed in the periaortic retroperitoneal space at the L4-L5 or L5-S1 level under CT or fluoroscopic guidance. In both procedures, a small volume of contrast material is injected to confirm the needles are correctly positioned, after which lidocaine followed by 25 ml of absolute alcohol is injected from each needle, followed by the injection of 5 ml of saline before needle withdrawal.

After the procedure is completed, bed rest is recommended for 12 hours, with hourly monitoring of blood pressure, heart rate, and vital signs. Intravenous fluid is recommended pre- and post-procedure because of the risk of hypotension. Common complications include transient pain from the procedure and diarrhea. Rarely, the procedure may result in neurological complications, vascular injury, or chemical peritonitis.

Neurolysis does not usually provide complete pain relief but helps to reduce the requirement for opioid analgesics and improves the patient's quality of life. Pain relief is long-lasting in 70-90% of patients who undergo celiac plexus neurolysis and the procedure may extend life by enhancing patients' ability to eat and perform day-to-day activities and by lowering the incidence of drug-related adverse effects. A similar fraction of patients report effective long-lasting pain relief and significant reduction in opioid consumption following neurolysis of the superior hypogastric plexus.

## Thermal Ablation for Pain Control

External beam radiation therapy remains the standard of care for localized pain due to bone metastasis. However, for many patients radiation therapy only provides partial reduction in pain, and relief is temporary. Thermal ablation



**Figure 3. PMMA injection for metastatic disease in acetabulum: A)** Shows needle placement and **B)** shows cement placement after completion of the procedure.

offers a highly effective alternate treatment. The treatment is suitable for patients experiencing pain of  $\geq 4$  on a 10-point scale, corresponding to one or two sites of metastasis. Osteolytic, mixed osteolytic-osteoblastic, or primarily soft tissue metastases are most amenable to thermal ablation.

Thermal ablation is performed via radiofrequency ablation (RFA) or cryoablation. Thermal ablation probes are best positioned under CT guidance. In some cases, a bone biopsy device or drill may be needed to establish an access tract for the ablation probe. The targeted lesions must be sufficiently separate from the central nervous system, major peripheral motor nerves, and critical structures such as bowel and bladder. In some cases, it may be possible to displace critical structures by the injection of fluid. Palliation depends on adequate coverage of the bone-tumor interface, rather than de-bulking the entire tumor. Several trials have demonstrated that thermal ablation is highly effective at reducing pain and many patients no longer required opioids to control their pain. Ambulation also improves. However, some patients experience a temporary increase in pain immediately following the RFA procedure.

Cryoablation has the important advantage of allowing therapy monitoring because the ice ball that develops can be seen as a well-margined low-attenuation region on CT (Figure 2) or a low-signal region on MR imaging. Ice is also able to penetrate deep into the bone, which may allow for a more complete treatment. Finally, unlike RFA, cryoablation does not result in a transient increase in pain after treatment. Eighty percent of patients reported decreased pain during a 24 week follow-up period, with a 50-100% reduction in pain at four weeks.

### Polymethylmethacrylate Cement Treatments

Injection of polymethylmethacrylate (PMMA) cement is a well-recognized treatment for vertebral compression fractures and spinal metastases (vertebral augmentation). Such injections, called osteoplasty or cementoplasty, are increasingly used to treat painful bony metastases at other sites (Figure 3), including the acetabulum, pelvis, femur, humerus and facial bones. PMMA injection may be used alone or in conjunction with thermal ablation. It is thought that coagulative necrosis resulting from thermal ablation allows more even distribution of the cement, which then helps to stabilize weight-bearing bone by sealing microfractures, decreasing the risk of fractures. In addition, PMMA is cytotoxic and produces heat as it cures, which may have a direct effect on nociceptors. Radiotherapy may be used to treat lesions after PMMA injections because it does not alter the mechanism of action of radiation on tumor cells, nor is it degraded by radiation.

PMMA injections are carried out under general anesthesia or local anesthesia and conscious sedation, using intermittent CT guidance to place the needle and monitor cement distribution. A large majority of patients experience durable pain relief, with improvements sometimes seen within the first 72 hours after treatment.

## Scheduling

Appointments for palliative interventional radiology therapies can be scheduled as follows. Call **617-726-1767** to schedule PMMA injections, **617-726-7717** to schedule bone RFA, and **617-726-8396** to schedule soft tissue thermal ablation and neurolysis procedures. The Financial Access Unit at Mass General Hospital takes care of pre-authorizations.

Interventional procedures are performed at the main campus only.

## Further Information

For more information about palliative interventional radiology, please contact [Avinash Kambadakone, MD](#), Abdominal Imaging and Intervention, Mass General Hospital, at **617-643-6315**.

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