Image-Guided Interventions in Oncology

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KEYWORDS

• Interventional oncology • Interventional radiology • Percutaneous therapies
• Image-guided procedures • Transarterial therapies

KEY POINTS

- Interventional radiology provides a wide range of minimally invasive procedures that play a critical role on the diagnosis, treatment, and palliation of patients with cancer.
- Percutaneous image-guided biopsy is an established method for obtaining tissue specimens with high diagnostic accuracy, few complications, and lower costs when compared with more invasive procedures.
- Percutaneous ablation can be used as an alternative to surgical resection in patients with primary and secondary malignancies with similar outcomes in selected cases.
- Image-guided procedures can be used in the management of the complications of malignancy, improving a patient's quality of life.

INTRODUCTION

In 1964, Dr Charles Dotter, using a combination of basic guidewires and catheters, successfully dilated a focal stenosis of the superficial femoral artery in a patient with painful leg ischemia and gangrene who had refused surgery, thereby reestablishing flow and saving her limb.[1] The success, and symbolism, of this procedure opened the way for a shift in a long-last paradigm in medicine: the use of medical imaging solely as a diagnostic tool. Over the subsequent 3 decades, the investigational mind and talent of many interventional radiologists and the unparalleled technological advances in medical imaging and material development were pivotal for the establishment of interventional radiology as a distinct medical specialty.

Interventional oncology, a term commonly used to refer to minimally invasive procedures performed by interventional radiologists for diagnosing and treating cancer,[2–5] accounts for a broad spectrum of procedures unique to interventional radiology that

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have demonstrated unequivocal clinical benefits and established their roles as an integral part of the multidisciplinary oncologic cancer care team.[2] This article provides an updated overview of the role of image-guided interventions in oncology.

CLINICAL USE OF IMAGE-GUIDED INTERVENTIONS

Cancer Diagnosis

The advances in morphologic and functional imaging of the past decade, along with an expanding accessibility and use of this technology, have led to dramatic improvements in diagnosing and monitoring cancer.[6–9] Nevertheless, accurate diagnosis invariably relies on obtaining adequate pathologic specimens. More recent understanding of molecular biology and the use of molecularly targeted agents in the cancer armamentarium have directed cancer treatment to targeted therapy. In this new horizon, the requirements for obtaining tumor tissue for diagnosis not only play a role in the diagnosis of the malignancy but also could potentially provide useful information that could tailor patient therapy, ultimately providing objective clinical response in selected patients.[10] Among the modalities for obtaining tumor tissue for histologic diagnosis, percutaneous image-guided biopsy (PIB) is a safe, well-established, and widely used method for obtaining tissue specimens with high diagnostic yield and few complications, making it the alternative for the vast majority of biopsies. PIB also reduces hospital length of stay, costs associated with biopsy, and patients' anxiety associated with a major surgical intervention.[11–13]

Various imaging modalities are used to guide percutaneous biopsies. These include fluoroscopy, ultrasonography, computed tomography (CT), CT fluoroscopy, magnetic resonance imaging, positron emission tomography-CT, and combinations of these modalities. The choice of imaging modality is based on the biopsy site, operation preference, potential access routes, ability to visualize the lesion, and the availability and cost of the equipment. Most interventional radiologists prefer the coaxial technique for PIB. This technique involves the initial placement of a thin-walled needle in or close to the target lesion and the advancement of fine-needle aspiration and cutting needles through the thin-walled needle to obtain tissue samples, which allows multiple tissue samples to be obtained without the need for additional passes through the overlying structures and thereby minimizing patient discomfort and complications. This technique also allows continuous access to the target lesion while the initial samples are being analyzed by the cytopathologist, creating an easy path for obtaining new specimens and thus potentially increasing the diagnostic yield (**Fig. 1**). Fine-needle aspiration uses thin-walled 20- to 25-gauge needles that provide specimens suitable for cytologic and microhistologic evaluations[14,15] with minimal risk of complications compared with core-needle biopsies. Cutting needles (or core needles) provide core specimens for histologic evaluation and are available in various calibers. Modern small-caliber (18- to 20-gauge) cutting needles consistently provide high-quality specimens without increasing complication rates.[16,17] With this technique, the success rate of PIB is 70% to 95%, depending on the mix of organ systems, lesion size, and lesion location and the relative proportion of benign versus malignant lesions that are sampled.[11] Further understanding of the sample adequacy for PIB intended for molecular testing and genetic analysis is a subject of current investigations.

Portal Vein Embolization

The incidence of primary liver cancer has continued to rise over the past decade in the United States, and liver metastasis is still frequent.[18] In patients with primary tumors and metastases confined to the liver, liver resection remains the mainstay of curative