EDITORIAL

Radiofrequency Ablation of Primary and Secondary Lung Tumors: Is the Promise of This Scalpel-Free Technique Now a Reality?

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Despite the important changes that have been brought about in the treatment of lung cancer in recent decades, one fact remains immutable: curative surgery continues to be the best therapeutic option.[1] Nonetheless, overall results for the treatment of non-small cell lung cancer, except when treated at the initial stages, are very disappointing.[2] It is believed that micrometastases that are not detectable histologically are very likely to be responsible for early recurrence and poor outcomes.[3]

Although surgical excision is considered the standard treatment when the disease is localized, it can only be performed in 1 in 4 diagnosed patients. Alternative therapies may need to be considered, depending on disease stage, associated comorbidity, functional situation, and even patient refusal to undergo surgery. To date, chemotherapy, radiotherapy, or a combination of both have been the alternatives used when surgery is not possible or is refused. Initial results obtained with stereotactic radiosurgery of lung tumors have shown that this technique also holds promise.[4]

In recent years, minimally invasive curative and palliative techniques have come to be considered as viable treatment alternatives. Video-assisted thoracic lobectomies performed by adequately trained staff have produced results that are similar to those of conventional surgery at early disease stages.[5] Complications are fewer and mean duration of hospital stay shorter after video-assisted surgery, which is likely to see the application of robotics in the future.[6]

Tumor ablation by means of a variety of tools from physical medicine—ultrasonic, radiofrequency or microwaves and cryotherapy—has gained ground in pulmonary oncology, given the reasonable success achieved in the treatment of tumors in other locations. Radiofrequency ablation is the most widely used of these techniques, and is, consequently, the one for which the greatest experience has accumulated. Very satisfactory results have been obtained in the treatment of certain kinds of liver metastases[7] and hepatocarcinomas,[8] with disease-free survival rates of 91% after 1 year and 98% after 2 years, respectively. The biological effects of radiofrequency are the result of using a high frequency (460 kHz to 480 kHz) alternating current to generate an electromagnetic field that heats tumor tissue to between 60ºC and 90ºC. A closed circuit is created between the source of the alternating current, the dispersion electrode, and the tumorous tissue in which impedance arises. The controlled application of heat causes coagulation necrosis of the treated tissue and induces programmed cell death.[9]

In 1983, Lilly et al[10] successfully used radiofrequency for the first time to treat a nonresectable lung carcinoma measuring 5 cm in diameter. Since then many authors have published studies that report reasonable disease-free survival rates.[11-19] Most have reported rates of over 70% at 1 or 2 years, but those figures are difficult to interpret because the studies drew no distinction between primary lung tumors and metastases from various locations; furthermore, for the lung cancers, no distinctions were drawn between different stages and tumor types.[20,21] The technique, moreover, is new and results obtained to date are very tentative, based as they are on only short-term follow-up. In 2006, Hiraki et al[22] published results for one of the largest series to date (128 patients and 342 lesions), reporting tumor-free survival for primary tumors and metastasis, respectively, of 72% and 84% at 1 year, 60% and 71% at 2 years, and 58% and 66% at 3 years.

Few authors have analyzed results separately for malignant primary tumors versus secondary tumors. Even fewer authors have compared radiofrequency ablation with the gold standard for treating primary lung cancer, namely, lobectomy.[5,23]

Two multicenter studies published in 1995 and 2002 that compared lobectomy and sublobar resection for stage 1 non-small cell lung cancer found that lobectomy resulted not only in a lower recurrence rate but also in a higher survival rate.[24,25] In the United States, mean survival at 5 years for patients who undergo a lobectomy for non-small cell lung cancer is 75% for stage I, 60% for stage II, and 15%

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for stage IIIA.[24-26] These are important data to take into account in order to correctly evaluate the technique for the same follow-up periods and the same clinical stages. Survival at 5 years for stage 1 non-small cell lung cancer treated with radiofrequency would be 27% if all lesion sizes were considered; this rate would go up to 45%, however, if only lesions measuring less than 3 cm were taken into account. One of the most important restrictions on the use of radiofrequency ablation for curative purposes is its exclusive indication—theoretically—for disease localized in the lung and without lymph node invasion (T1-2N0). Nonetheless, a number of studies have reported promising results for treatments based on a combination of radiotherapy and chemotherapy.[5,23,27,28]

The use of radiofrequency to treat lung metastases merits special consideration, given that some studies have reported a survival rate at 5 years that is as good as, if not better than, that for surgery—at 45% compared to 32.4%.[27,29-31]

Radiofrequency ablation is a safe technique, with a rate of complications of 20% to 40% (mainly pneumothorax, which only requires chest tube placement in 10% of cases) and a 30-day mortality rate of 3% to 5%.[27-33] Despite generally satisfactory results, however, a number of problems remain that are largely inherent to the technique. The fact that electrodes are only available for diameters of less than 5 cm means that radiofrequency ablation can only be used for small lesions; furthermore there is no guarantee that a tumor-free margin has been achieved unless the thermal treatment is applied well beyond the perimeter of the lesion, even though the issue of margin has been studied intensively in animal models.[34-37] In 8 patients with stage I-II non-small cell lung cancer, Nguyen et al[38] performed lung radiofrequency ablation through a conventional thoracotomy followed by a lobectomy. The histological study for 3 (37.5%) patients demonstrated complete necrosis for lesions measuring less than 2 cm in diameter, with the remaining, larger lesions showing incomplete ablation.

Percutaneous procedures for the treatment of malignant lung lesions have benefited, like surgery, from technological advances in imaging techniques, such as computed tomography, magnetic resonance, positron emission tomography, and hybrid computed tomography-positron emission tomography systems, all of which play a key role in disease diagnosis, staging, and follow-up. Radiofrequency ablation needs to be guided by imaging technology, preferably computed tomography.[15-17,39,40] The problem with this reliance on images is that the physical location of the tomograph is less than ideal. Radiofrequency ablation is preferably performed with anesthetized and sedated patients; it also requires direct monitoring and the presence of an intensive care specialist or an anesthetist. These requirements all represent additional complexities in the event that complications occur. One approach to minimizing these difficulties would be to have the tomographic equipment set up in a room suitably equipped for such procedures.[41]

In conclusion, radiofrequency represents yet another option for treating malignant lung lesions. Apart from its promise, it is a safe technique—particularly when we consider that fewer than 25% of all lung neoplasms are resectable at the time of diagnosis.[7,26,42] Radiofrequency allows the primary lesion to be treated at the same time as metastases to neighboring organs such as the liver (particularly the adrenal glands).[43] Nonetheless, equipment needs to be improved and we need to acquire a deeper understanding of physical medicine resources and interaction with lung tissues. This will require teamwork and the creation of multidisciplinary groups so as to gradually and appropriately channel and direct research efforts. One such team has been established under the sponsorship of the Spanish Society of Pulmonology and Thoracic Surgery (SEPAR) and the Spanish Society of Medical Radiology (SERAM). Called the Spanish Multidisciplinary Study Group for Radiofrequency Treatment of Lung Tumors (GEMUR), it is currently working on the design of a registry and medical guidelines for specialists interested in radiofrequency.

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