

# **Irreversible electroporation and the future of interventional oncology**

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## **Introduction**

Image-guided percutaneous ablation techniques performed by interventional oncologists provide an alternative to surgery in selected cases for both curative and palliative<sup>1</sup> intents. Older techniques use thermal energy, such as radiofrequency ablation, microwave ablation and cryoablation. While these techniques have more evidence, they have limitations that irreversible electroporation (IRE) can potentially overcome.

IRE is a newer ablative technique that uses electricity. Needles are inserted percutaneously, laparoscopically or via open surgery. Repeated applications of short high voltage electrical pulses are delivered between electrodes, causing nanopores in cell membranes.<sup>2</sup> This causes cell death through apoptosis.<sup>3</sup> IRE has been used in trials in renal, liver, lung and pancreatic lesions.<sup>4</sup>

The properties of IRE allow it to be used near vital structures. As IRE does not use heat, it is not affected by the heat-sink effect when used near blood vessels. It is also viable near heat-vulnerable structures like nerves and bile ducts.<sup>5</sup> Moreover, there is clear demarcation between ablated tissue and non-ablated tissue, which limits damage to surrounding tissues.<sup>6</sup> These features may allow IRE to overcome problems with thermal techniques.

Some downsides include long<sup>6</sup> treatment times, need for general anaesthesia for deep muscle relaxation and ECG synchronised pulsing<sup>7</sup> due to the risk of

arrhythmias from high voltage electricity. Other possible negative effects include myoclonus and epileptic seizures.

### **Renal cell carcinoma (RCC)**

Patients unfit for surgery with cT1a renal masses smaller than 3 cm are treated with curative intent with ablation techniques like cryoablation, with good outcomes and preservation of renal function.<sup>8</sup> However, in some tumours, the large ablation zone of these techniques may extend to the renal pelvis and ureters. IRE is potentially useful in such cases.<sup>6</sup>

In the IRENE<sup>9</sup> trial which evaluated IRE of localised RCC with tumour resection afterwards, IRE resulted in complete tumour destruction and regeneration of the urine collection system. The authors suggested that IRE is safe and potentially useful for centrally located tumours near the renal hilum.

### **Pancreatic cancer**

A majority of patients present with locally advanced (LAPC) and metastatic pancreatic cancer at diagnosis which are not amenable to curative surgical resection. In such cases, thermal ablative techniques can improve survival, shrink tumours for resection and improve symptoms. However, in tumours close to vital structures, thermal energy can cause bile leaks and bleeding. For these tumours, IRE can be a viable solution<sup>10</sup> to improve the poor prognosis of this aggressive cancer.

In a systematic review<sup>11</sup> which assessed IRE of LAPC, 33% of cases had morbidity associated with IRE, with the least morbidity when performed percutaneously. While some studies cited possible improvement in survival, the overall data about the long-term outcomes of IRE is inconclusive, requiring higher level of evidence.

## **Conclusion**

Despite its disadvantages, IRE can potentially benefit IR services in selected cases. It gives the interventional oncologist another tool for ablating difficult lesions that would otherwise be unsuitable for treatment, possibly improving the morbidity and mortality of these patients. More evidence is still needed for this promising novel intervention.

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