

**Name:**

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**Foundation Year 2**

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**Topic chosen:**

**1. Describe an innovation/research area in interventional radiology and discuss its impact on current/future IR practices.**

**Essay title:**

**Irreversible electroporation: a promising avenue in cancer treatment.**

Recent statistics show that 1 in 2 people in the UK will be diagnosed with some form of cancer during their lifetime <sup>1</sup>. In 2016, all types of cancers accounted for 28% of deaths in the UK <sup>1</sup>. Cancer treatment was originally based on medical, surgical and radiotherapy approaches. Nowadays, interventional radiology constitutes the fourth pillar of cancer treatment, offering innovative tumour-targeting techniques. Despite recent advances in cancer treatment, certain cancers, such as pancreatic cancer, are associated with a 10-year survival of less than 1%, a figure that has not improved since the 1970s <sup>2</sup>.

Traditional methods for tumour ablation include microwave, radiofrequency ablation, cryotherapy and high-intensity focused ultrasound. However, these techniques have been associated with a high risk of damage to surrounding structures. Non-thermal tumour ablation, via the form of irreversible electroporation (IRE), is one of the newest techniques used by interventional radiologists to treat cancers. Fine antennae are used to deliver high-voltage electrical impulses, hence damaging cell membranes and inducing apoptosis in cancer cells <sup>3,4</sup>. It is less likely to cause damage to surrounding structures than thermal ablation methods <sup>3</sup>.

Considering the aforementioned statistics on poor pancreatic cancer outcomes, it would be interesting to see if IRE could optimize survival rates. In fact, *Martin et al* concluded in a study of 200 patients with localised advanced pancreatic cancer that open IRE after induction chemotherapy resulted in a median overall survival of 24.9 months <sup>5</sup>. Some cohort studies looking at combination radiofrequency ablation with chemotherapy on localized advanced pancreatic cancer concluded an overall survival between 19.0 and 25.6 months <sup>6</sup>. The chemotherapy treatment alone leads to a 14–16 months survival <sup>7</sup>. These findings suggest that combination IRE with chemotherapy treatment shows some promising results, although further studies are needed with large cohorts of specific patient groups and longer follow-up times.

As a matter of patient safety, awareness of potential complications of IRE is crucial when deciding on its suitability. Standard complications include pain, bleeding, abscess formation, damage to surrounding structures and local organs. In addition, it could potentially lead to muscle contraction and damage, precipitating rhabdomyolysis and acute kidney injury<sup>3,4</sup>. Therefore, it is advisable that patients undergo general anaesthesia prior to the treatment. Furthermore, any cardiovascular comorbidities are a contraindication due to a risk of cardiac arrhythmias during the procedure<sup>3</sup>.

So far, IRE tends to be used for tumors of the pancreas, kidneys, liver and prostate, with particular success in the latter two<sup>3</sup>. Despite it being applied to treat thyroid, breast, lung, and bone cancers, its use in these types of cancers is not as common<sup>3</sup>. Further studies are needed to establish the reliability of IRE as a cancer treatment modality by applying it to various solid tumours and comparing with the outcomes from different ablation techniques. Finally, IRE is proving to be an invaluable tool in the field of interventional oncology, yielding some very promising results, particularly with tumours located adjacent to critical structures<sup>3</sup>.

### **References:**

1. Cancer Statistics for the UK [Internet]. Cancer Research UK. 2019 [cited 16 August 2019]. Available from: <https://www.cancerresearchuk.org/health-professional/cancer-statistics-for-the-uk#heading-Three>
2. Pancreatic cancer statistics [Internet]. Cancer Research UK. 2019 [cited 16 August 2019]. Available from: <https://www.cancerresearchuk.org/health-professional/cancer-statistics/statistics-by-cancer-type/pancreatic-cancer#heading-Two>
3. Hsiao C, Huang K. Irreversible Electroporation: A Novel Ultrasound-guided Modality for Non-thermal Tumor Ablation. *Journal of Medical Ultrasound*. 2017;25(4):195-200.
4. Saini A, Breen I, Alzubaidi S, Pershad Y, Sheth R, Naidu S et al. Irreversible Electroporation in Liver Cancers and Whole Organ Engineering. *Journal of Clinical Medicine*. 2018;8(1):22.

5. Martin R, Kwon D, Chalikonda S, Sellers M, Kotz E, Scoggins C et al. Treatment of 200 Locally Advanced (Stage III) Pancreatic Adenocarcinoma Patients With Irreversible Electroporation. *Annals of Surgery*. 2015;262(3):486-494.
6. Ruarus A, Vroomen L, Puijk R, Scheffer H, Meijerink M. Locally Advanced Pancreatic Cancer: A Review of Local Ablative Therapies. *Cancers*. 2018;10(1):16.
7. Van Veldhuisen E, Van den Oord C, Brada L, Walma M, Vogel J, Wilmink J et al. Locally Advanced Pancreatic Cancer: Work-Up, Staging, and Local Intervention Strategies. *Cancers*. 2019;11(7):976.