

# Irreversible Electroporation: A New Hope for the Pancreatic Cancer Patients

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## Editorial

The grave situation with pancreatic cancer is illustrated in Figure 1 [1]. It shows that for the period of 1992-2011 [1], the number of incidences of new cases and the death are almost alike. This indicates the pitiful survival rate of pancreatic cancers. Pancreatic cancer is one of the deadliest cancers, with the highest mortality rate of up to 90%. In the US, it is the 4th leading cause of cancer deaths in both men and women. The majority of pancreatic cancers are pancreatic adenocarcinoma, occurring in the exocrine cells of the pancreas [2,3].

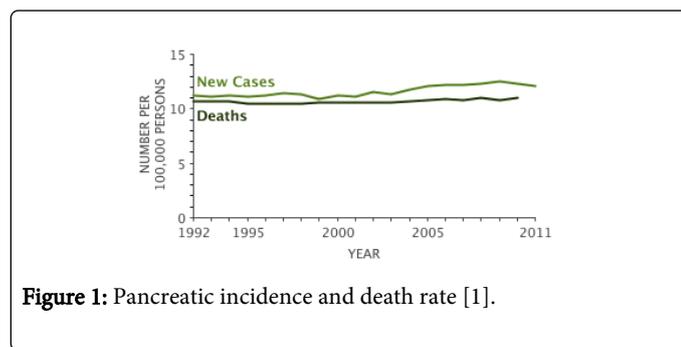


Figure 1: Pancreatic incidence and death rate [1].

The current standard of cure is surgery, chemotherapy (both neoadjuvant and adjuvant) and radiation. Neoadjuvant chemotherapy is given for the reduction of tumor size before the surgery. Adjuvant chemotherapy is systemic, given to destroy and/or reduce the proliferation of the malignant cells existing already in the body that were not removed by the surgery. Radiation is given, both for palliative and curative purposes, after surgery or alone. Surgery is possible only for Stages IA and IIA tumors, wherein the tumor size is less than 2cm and more than 2cm respectively and they are completely inside the pancreas [2], they didn't spread to nearby organs or elsewhere. The surgery known as Whipple procedure (after the surgeon who regulated it) involves the removal of the following [2]:

- Head of the pancreas (most of the pancreatic cancer occurs in the head of the head, neck, body and tail of the pancreas)

- Lymph nodes draining that part of the pancreas

- Part of the bile duct that drains bile from the liver into the small intestine)

- Gallbladder

- Most of the duodenum (first part of the small intestine).

- The stomach is saved along with the first portion of the duodenum.

In some cases, the whole of the duodenum is removed, along with a small portion of the stomach. The intent is to remove the entire tumor. Then, the remaining pancreas, bile duct, stomach, duodenum (if any),

and the small intestine are reconnected. The whole procedure takes 5-8 hours and the hospital stay is 7-10days.

There are also other surgery procedures, including Distal Pancreatectomy, Laparoscopic surgery, Total Pancreatectomy, neoadjuvant therapy and adjuvant therapy [2]. The palliative procedures include surgical bypass, stents, chemotherapy, radiation, immunotherapy, and targeted biological therapy [2].

Despite all these, the poor quality of life (surgery, radiation, chemoradiation and chemotherapy have their share of side effects and physical discomfort, pain, suffering and other issues which reduce the quality of life much [2,3]), and the high mortality rate clearly indicates that these procedures are inadequate. This necessitates the use of novel/alternative therapies. Towards this, electrical pulse-mediated therapies could be utilized, with or without drugs.

It is described as “potential boon for pancreatic cancers”, by the Johns Hopkins surgeons [4]. They have initiated a drug-free, electrical pulse-based therapy, known as, irreversible electroporation (IRE) which involves just application of application of short high voltage pulses to irreversibly permeabilize the cell membranes that eventually undergo cell death for pancreatic cancer treatment and feel that the pancreatic patients have one more option [4-11]. Ultrasound-guided needles are used to apply the pulses on the tumors. Their patient selection included those with locally advanced disease, who have already exhausted traditional systemic (chemotherapy) and local therapy (radiation) options and continue to remain free of distant metastasis.

It was also performed at the Division of Surgical Oncology, Dept. of Surgery and James Graham Brown Cancer Center, University of Louisville School of Medicine [6,7]. This study involved a prospective, multi-institutional evaluation of 54 patients, with locally advanced unresectable pancreatic adenocarcinoma (LAC), from December 2009 to October 2010. The results indicate that the IRE non-thermal ablation is safe and effective, and using this it is possible to obtain great local palliation and potential improved overall survival compared to conventional therapies, such as standard chemoradiation-chemotherapy treatments [6]. In another study by the same group, 27 patients were treated with IRE alone or IRE plus resection for LAC. The median size tumor was 3cm. 85% of these patients had multiple lines of previous chemotherapy and chemoradiation therapy. In addition, all these patients had locally advanced pain due to celiac plexus invasion. The results indicated that IRE ablation is safe and feasible as a primary local treatment in unresectable LAC. Similar opinion was also shared by the Uppala University in Sweden for unresectable IAC. The researchers found that that their percutaneous IRE for LAC appears to be efficacious, promising and safe. Narayan et al also make similar conclusions based on their treatment of percutaneous IRWin the management of pancreatic cancer [10].

Given the anatomical location and function of the pancreas (close to the stomach and other organs) and with close proximity to two major vasculatures (the superior mesenteric artery and the superior mesenteric vein, which are behind the neck of the pancreas [2]), IRE is superior compared to thermal ablation and RF ablation techniques. For example, in the case of thermal ablation, thermal energy can dissipate from the tumor to the nearby major blood vessels. RF ablation also release energy to surrounding tissues and affect the vascularity and the connective tissues [11]. There are no issues of drug side effects and drug resistance. Thus, IRE has the promise for a good future of the pancreatic patients.

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