

Postoperative monitoring after cryoablation of pancreatic tumors

Poster No.: C-2887
Congress: ECR 2019
Type: Scientific Exhibit
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Keywords: Metastases, Cancer, Ablation procedures, Ultrasound, MR, CT, Pancreas, Oncology, Abdomen
DOI: 10.26044/ecr2019/C-2887

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Aims and objectives

Malignant pancreatic tumors are common. In patients with malignant pancreatic tumors five-year survival rate does not exceed 5% and the only radical treatment is surgery. Due to early vascular invasion, most of pancreatic tumors at the time of diagnosis are unresectable. Up to 40-45% of patients with locally advanced pancreatic tumors at the time of diagnosis have liver metastases, while the median survival in this group does not exceed 3-6 months. Radical surgery is possible only in 5-25% of patients with malignant pancreatic tumors. However, the survival rate even after radical surgical treatment and aggressive chemotherapy remains extremely low - 5-year survival does not exceed 29% [1].

Nowadays, cryoablation is a promising method of palliative treatment of locally advanced pancreatic cancer. Cryosurgery is based on the effect of extremely low temperatures on the tumor tissue. Some studies of ultra-low temperature effects on various tissues in vivo in vitro have proven the effectiveness of this technique [2-5].

Study purpose: to evaluate of the completeness of cryoablation (CA) in patients with malignant pancreatic tumors by imaging methods

Methods and materials

21 patients with malignant pancreatic tumors underwent CA of the tumor. Duplex ultrasound, CT and MRI were performed before and after operation: on 1st day, after 3 months, 6 months.

Duplex ultrasound criteria of the completeness of CA in pancreatic tumors: blood flow changes in the tumor.

CT criteria of the completeness of CA in pancreatic tumors: tumor contrast enhancement changes (tumor density calculation by formula: $[\text{tumor density}_{\text{CE phase}} - \text{tumor density}_{\text{native}}] / \text{aorta blood density}_{\text{CE phase}}$); also changes of tumor size, signs of vascular invasion and the severity of pancreatic hypertension were evaluated at 3 and 6 months after CA.

MRI criteria of the completeness of CA in pancreas tumors: apparent diffusion coefficient increase in pancreatic tumor; also changes of tumor size, signs of vascular invasion and the severity of pancreatic hypertension were evaluated at 3 and 6 months after CA.

Results

Duplex ultrasound showed blood flow decrease in the tumor.

MRI in the first day after pancreatic tumor CA is poorly informative due to significant focal edema, the area of edema overlapped the tumor. Before CA, the average apparent diffusion coefficient value in tumor was $0.96 \text{ mm}^2/\text{s}$. On the first day, average apparent diffusion coefficient value in tumor was $1.07 \text{ mm}^2/\text{s}$. Fig 1.

The MRI at 3 months, 6 months showed average apparent diffusion coefficient value increase in tumor, $1.2 \text{ mm}^2/\text{s}$ and $0.94 \text{ mm}^2/\text{s}$, respectively. Fig.2

Contrast enhanced CT showed that contrast accumulation in pancreatic tumors after CA was less pronounced than before CA. The calculated average values of contrast accumulation on the 1st day after CA in arterial, venous and delayed phases were 0.05, 0.18, 0.35, respectively.

Calculated average values of contrast accumulation after CA in the arterial, venous and delayed phases at 3 months and 6 months were 0.04, 0.17, 0.44 and 0.05, 0.22, 0.54, respectively.

Gradual narrowing of vessels lumen was noted. The size of the CA zone did not change after 3 and 6 months.

The average tumor size before CA was 38 mm. After CA at 3 months and 6 months, the average tumor size was 38 mm and 39 mm, respectively.

Pancreatic hypertension increased slightly. The average value of pancreatic duct diameter before CA was 6.3 mm. After CA at 3 months and 6 months values of pancreatic duct diameter were 6.3 mm and 8 mm, respectively. Fig.3

Images for this section:

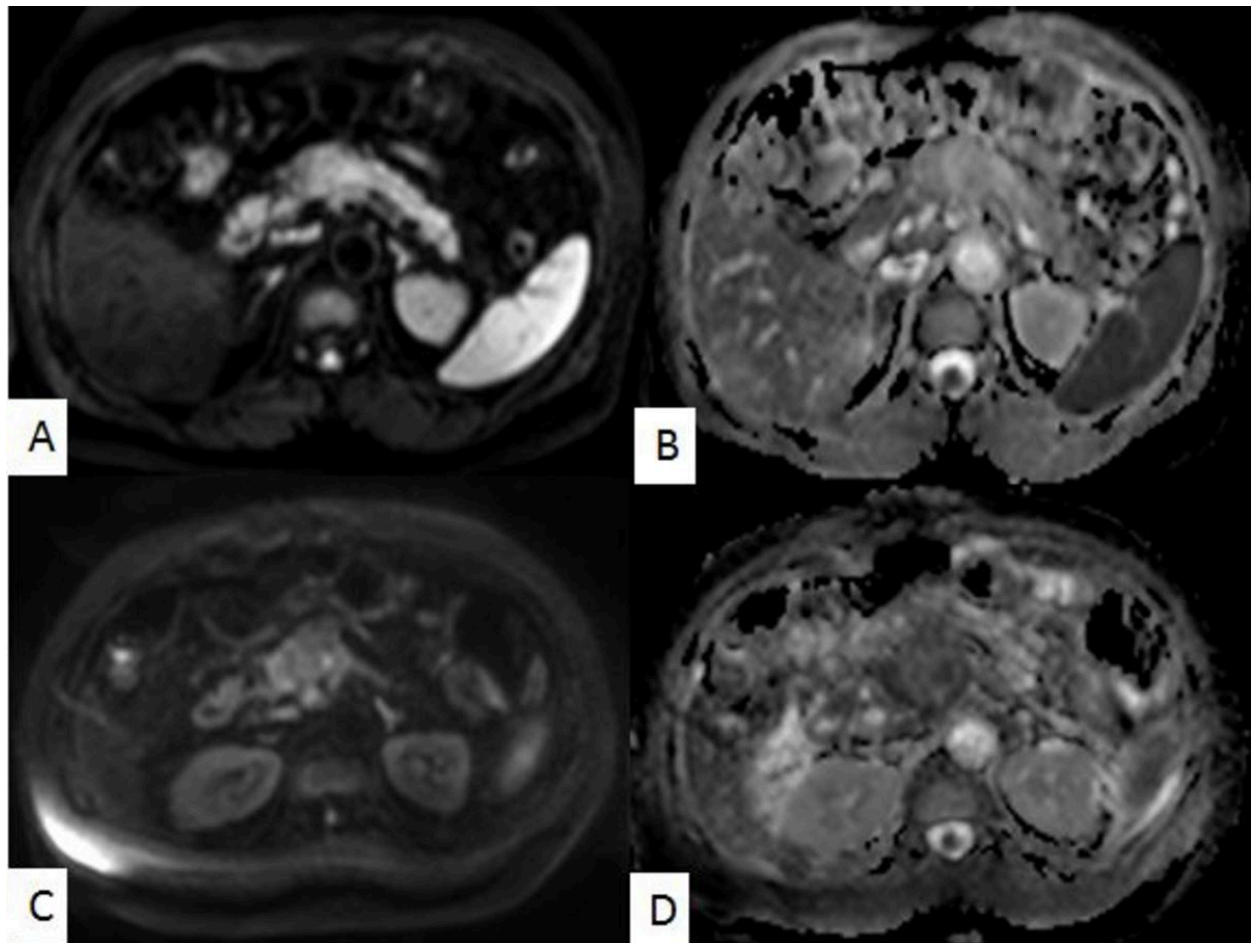


Fig. 1: Magnetic resonance imaging, A - DWI before cryoablation, B - ADC map before cryoablation, C- DWI, 1st day after cryoablation, D - ADC map 1st day after cryoablation. On the first day after cryoablation, DWI/ADC map show significant edema of tumor and retropancreatic fat.

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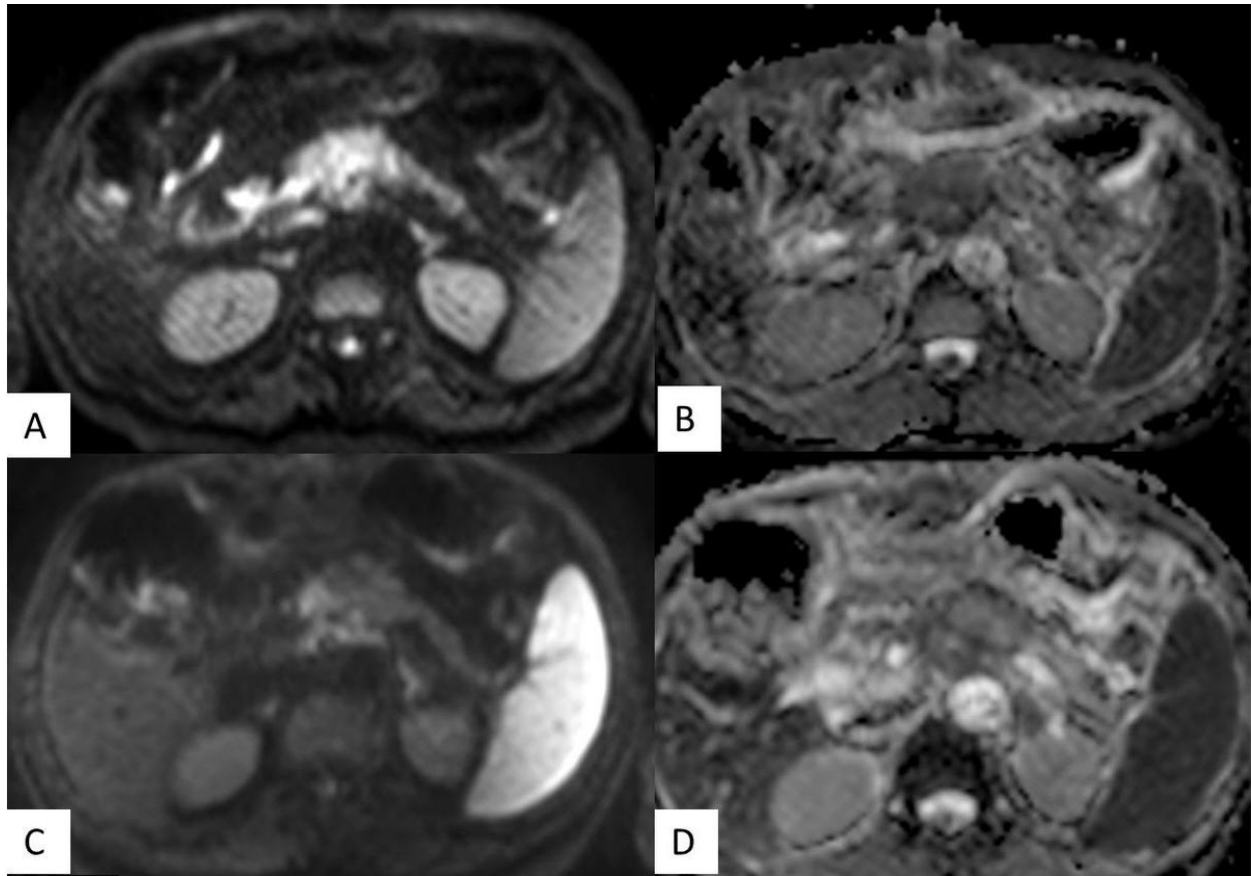


Fig. 2: Magnetic resonance imaging, A - DWI , 3 months after cryoablation, B - ADC map, 3 months after cryoablation, C- DWI, 6 months after cryoablation, D - ADC map, 6 months after cryoablation

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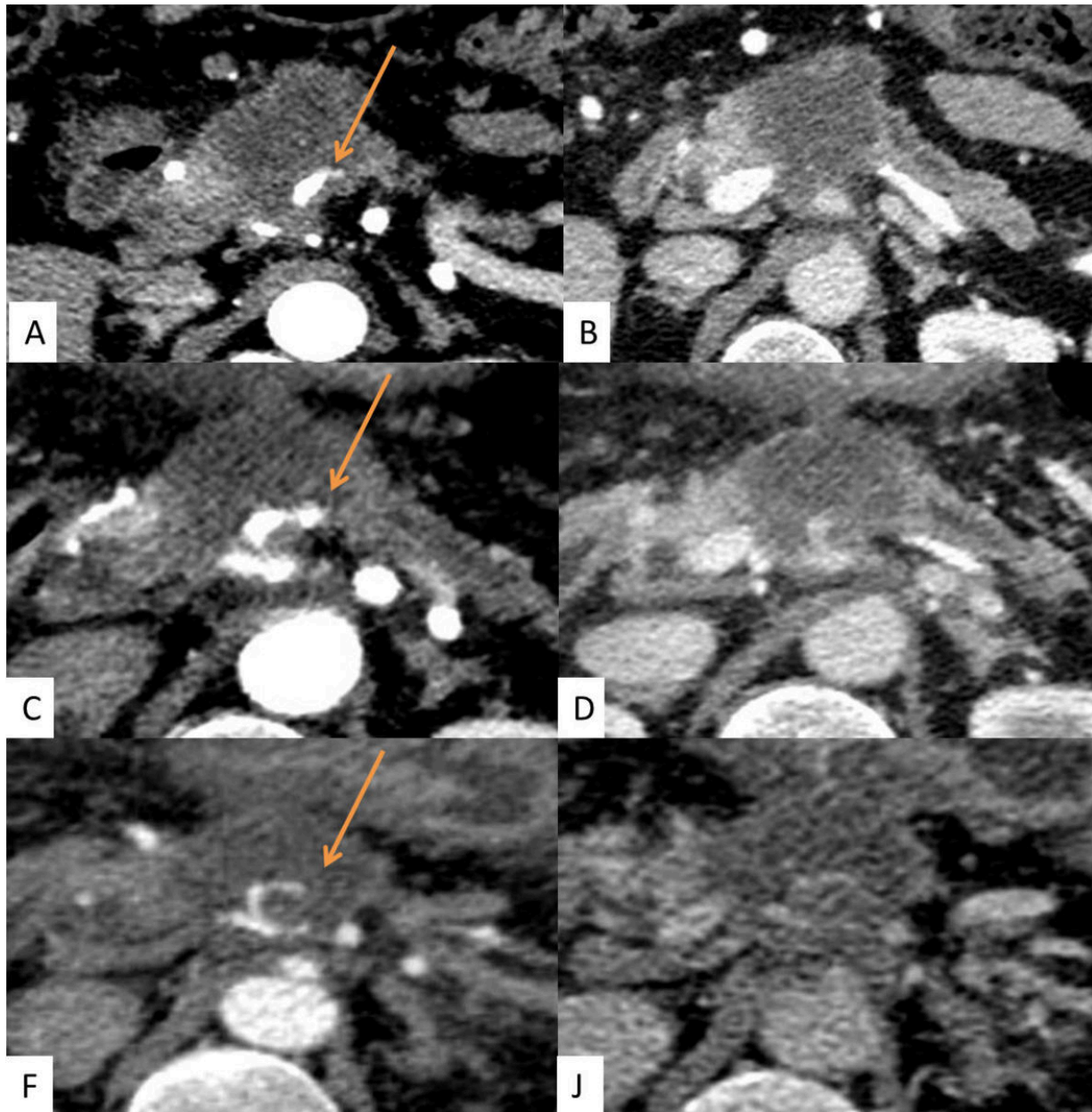


Fig. 3: Contrast enhanced computed tomography, axial sections, A - arterial phase, before CA, B - venous phase, before CA, C - arterial phase, 3 months after cryoablation, D - venous phase, 3 months after cryoablation, F- arterial phase, 6 months after cryoablation, J - venous phase, 6 months after cryoablation. Hypovascular tumor of pancreatic body, no changes of size of the tumor, the degree of pancreatic hypertension is the same, progressive narrowing of encased vessels.

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Conclusion

Ultrasound at 3 months and 6 months showed a significant decrease of blood flow in pancreatic tumors after CA.

MRI showed apparent diffusion coefficient values increase in pancreatic tumors after CA.

Contrast enhanced computed tomography showed marked increase of contrast agent accumulation by pancreatic tumor in delayed phase at 3 months and 6 months after CA, which probably indicates the formation of fibrous tissue. The size of the cryoablation zone did not change. The degree of pancreatic hypertension slightly increased.

These criteria can be used to assess the completeness of pancreatic tumor cryoablation.

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