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PRELIMINARY RESULTS OF FAST  
NEUTRON TREATMENTS IN  
CARCINOMA OF THE PANCREAS



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## PRELIMINARY RESULTS OF FAST NEUTRON TREATMENTS

### IN CARCINOMA OF THE PANCREAS

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Between December 1977 and March 1978 thirty patients with histologically proven carcinoma of the pancreas were treated at the Cleveland Clinic and NASA Lewis Research Center cyclotron. The cyclotron is located approximately 20 minutes from the Clinic Radiotherapy Department and offers the to-date unique opportunity to treat deep-seated abdominal, pelvic, and thoracic tumors with a vertical neutron beam.

Throughout the report period, the neutrons were produced by a 25-MeV deuteron on beryllium reaction offering depth dose characteristics very similar to those of a cobalt beam; that is, approximately 50 percent of  $D_{max}$  dose at 10 centimeters depth with  $D_{max}$  at approximately 4 millimeters. The photon treatments were delivered at the Cleveland Clinic with a 10-MeV linear accelerator.

For tumor localization, surgical clips were available in most patients; in the remaining few, barium swallows and CAT scans were used for precise localization. After defining tumor and target volume by those means, treatment portals were mapped out with the help of a fluoroscopic simulation technique and subsequently verified in all cases by CAT scanning. The unique feature of a vertical neutron beam allowed CAT scan verification and localization in the actual treatment position. Day-to-day reproduction of patient positioning was further aided by a sophisticated laser system. Patients were usually treated with a four gamma field and a two neutron field technique. The gamma fields were parallel opposed AP & PA and lateral, and the neutron fields were parallel opposed AP & PA. Typical field sizes were 12 centimeters by 10 centimeters for both the AP-PA and lateral fields.

All patients were treated with the so-called mixed beam, that is, photon treatments on Monday, Wednesday, and Friday at the Cleveland Clinic and neutron treatments on Tuesday and Thursday at the cyclotron facility. A neutron RBE of 3.33 was used to convert 60 neutron rads to 200 equivalent rads per treatment; this regimen results in 40 percent of the equivalent dose coming from the neutron component. All patients in this report were treated to a total dose of 6000 equivalent rads in 30 fractions over 6 to 8 weeks. In the initial phase of this trial, patient acceptance was very liberal. Five of the patients had liver metastases at the time of treatment, six others had extensive regional disease, and in 19 the extent of the disease was described as 'localized'. Eighteen of 30 patients presented with jaundice, 20 of 30 with weight loss, 17 of 30 with pain, and 22 of 30 had had some form of surgical bypass operation. All patients had a diagnostic laparotomy and histological verification of their malignancy. At the time of this review, the tumor grading was known in 20 patients.

## RESULTS

Treatment was generally well tolerated. Mild diarrhea and nausea were common but easily controlled with conservative treatment. The majority of patients received significant palliation of their symptoms with improvement of the main symptom reported in 26 of 30 cases and weight gain reported in 15 of 30 cases.

At the time of this review four patients were still alive, two at more than 2 years. From the date of diagnosis the 12 months survival was 33 percent, the median survival 7 months or 210 days. Twenty-one patients with carcinoma of the head of the pancreas did slightly better at 9 months median survival versus 6.5 months in the remainder of the group.

From the reported onset of symptoms to death, patients with carcinoma of the head of the pancreas have survived 10 months compared to patients with body and tail of the pancreas carcinomas who survived 13 months from the recorded onset of symptoms. Patients with the presenting symptom of jaundice did slightly better at 7 months median survival than did those with the presenting symptom of weight loss with a median survival of 6 months. As expected, patients with poorly differentiated carcinoma had a shorter median survival at 5 months compared to patients with moderately differentiated carcinoma and a median survival of 9 months. Also patients who were considered to have localized or regional disease survived 9 months compared to a median survival of patients with extensive disease of 5 months.

At the time of this review, four patients were known to have had episode of bleeding gastric or duodenal ulcers. At least one of those patients was endoscopically biopsied and was found to have a tumor. One patient had gangrene of the small bowel with volvulus after choledochojejunostomy. These problems developed between 4 and 12 months after treatment.

## CONCLUSIONS

Our initial clinical impression is that the treatments were well tolerated with early morbidity similar to conventional treatment modalities. Significant palliation was obtained in most patients.

We feel encouraged to proceed with a well-controlled clinical trial to test the merit of mixed beam versus conventional precision high dose photon treatments. Careful surgical selection of truly localized carcinomas with meticulous care devoted to outlining the tumor volume with radio-opaque clips is imperative.

High precision techniques for tumor localization and verification are essential to evaluate the true value of radiotherapy in this disease for long-term palliation or cure.

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16. Abstract <p>A group of 30 patients with adenocarcinoma of the pancreas including some patients with very advanced disease, were treated in a Pilot Phase 2 Study. All patients were treated with the so-called mixed beam modality employing photon treatments three times per week and neutron treatments twice a week. 200 Rads or equivalent rads (RBE 3.3) were given in daily fractions aiming at a total dose of 6000 rads in 6 to 8 weeks. The treatments were well tolerated and significant palliation was achieved in 26 of 30 cases. Twelve months survival was 33 percent with a median survival of 7 months or 210 days. Treatment techniques and localization procedures are discussed in the paper.</p>			
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