

Survival of Patients with Cancer of the Pancreas in Relation to Findings on Arteriography

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IN THE PAST DECADE, various approaches for detecting cancer of the pancreas have been attempted by many investigators. Few reports, however, have included the prognostic significance of these preoperative diagnostic procedures. It is also of paramount importance to predict the clinical course of this disease and establish the mode of therapy.

The present study evaluates the significance of selective arteriography in survivors with cancer of the pancreas. The results of this study indicate that there is a definite correlation between survival and angiographic findings. Based on this relationship, a new classification, which is useful for the choice of the treatment and prediction of behavior of this disease, is proposed.

Material and Method

During the past 7 years, preoperative arteriography was carried out in our clinic on 65 patients with adenocarcinoma of the pancreas. Histology showed that all the lesions arose from the ductal epithelium. There were seven patients with cancer of the ampulla of Vater, 36 with cancer of the pancreatic head, 16 with cancer of the pancreatic body and six with cancer of the entire pancreas. The patients ranging from 28 to 75 years of age consisted of 43 men and 22 women.

Selective arteriography was carried out with the Seldinger method under television fluoroscopy using a yellow kifa curve-end catheter. Thirty to forty ml. of 66.8% sodium iothalamate was injected into the celiac trunk and then into the superior mesenteric artery at a rate of 10 ml. per second. The arterial, capillary and venous phases were recorded on film for 20 seconds. In almost all instances, the right posterior oblique projec-

tion was added to the antero-posterior for a detailed demonstration of the pathologic conditions. In some cases, superselective angiography of the common hepatic, splenic or gastroduodenal arteries was combined.

The arteries related to the pancreas were divided into the following three types: the arteries confined to the pancreas, the arteries adjacent to the pancreas and the arteries of the extrapancreatic organs. The arteries confined to the pancreas consisted of the anterior superior pancreaticoduodenal artery, anterior inferior pancreaticoduodenal artery, posterior superior pancreaticoduodenal artery, posterior inferior pancreaticoduodenal artery, dorsal pancreatic artery, transverse pancreatic artery, pancreatica magna artery and their branches. The arteries adjacent to the pancreas were the gastroduodenal artery, common hepatic artery, celiac trunk, superior mesenteric artery and splenic artery. The arteries of the extrapancreatic organs were the jejunal arteries, middle colic artery, proper hepatic artery, gastric artery, gastroepiploic artery, inferior phrenic artery and so forth. Based on the extent of invasion by the tumor into these kinds of arteries, cancer of the pancreas was angiographically classified into four groups. Group 1 cancer was that in which the invaded arteries were radiologically limited to those confined to the pancreas; group 2 cancer was that in which invasion of the tumor extended to the arteries adjacent to the pancreas; group 3 cancer was that in which invasion of the tumor extended to the arteries of the extrapancreatic organs; and group 4 cancer was that in which liver metastasis was demonstrated, irrespective of the size of the original lesion. Those in whom

arteriograms showed no evidence of abnormality were involved in group 1 cancer. Figures 1, 2, 3 and 4 show the arteriograms in each group of the patients.

Within 1 or 2 weeks after arteriography, almost all of the patients underwent the various surgical procedures such as pancreatoduodenectomy, distal pancreatectomy, biliodigestive anastomosis, gastrojejunostomy and exploratory laparotomy. Excluding the patients who died immediately after operation, survivals of each group were reviewed.

Results

Adenocarcinoma of the pancreas which angiographically belong to group 1 accounted for 18 of 65 cases (seven with cancer of the ampulla, ten with cancer of the head and one with cancer of the body). Group 2 cancer accounted for 12 cases (seven with cancer of the head and five with cancer of the body); in group 3 cancer there were 12 cases (eight with cancer of the head, two with cancer of the body and two with cancer of the entire pancreas), and group 4 cancer had 23 cases (11 with cancer of the head, eight with cancer of the body and four with cancer of the entire pancreas). One or 2 weeks after angiography, various surgical procedures were performed. Pancreatoduodenectomy was performed in 15 patients of whom seven had cancer of the ampulla and eight had cancer of the head. Distal pancreatectomy was performed on two patients with cancer of the body. The remaining 48 patients had the unresectable type of disease and bypass operation or exploratory laparotomy was performed. Of 17 patients who had resectable lesions, 13 were in group 1, three were in group 2 and one

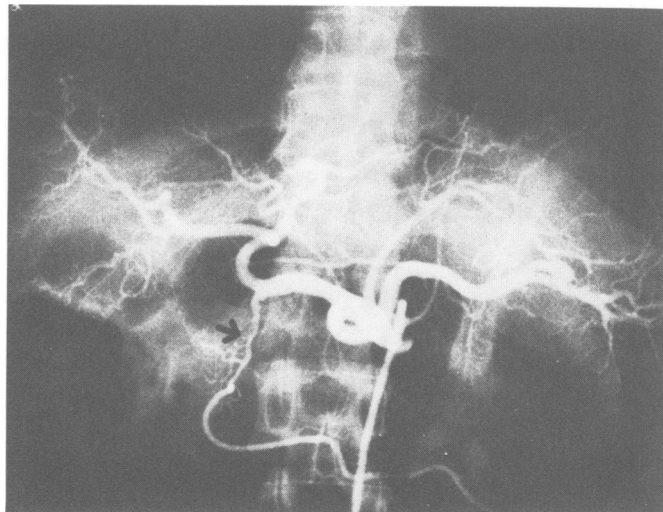


FIG. 2. Angiogram of the celiac trunk in a patient in group 2 (cancer of the head of the pancreas). Invasion by the tumor extends into the gastroduodenal artery (arrow).

was in group 4. The last patient had cancer of the pancreatic body and underwent distal pancreatectomy and left hemihepatectomy for liver metastasis. In group 3 cancer, no lesion could be resected. Figures 5 and 6 summarize the incidence and resectability in each group of the patients.

Of the 65 occurrences, two patients died immediately after operation and nine are still alive. Consequently, 54 patients including five with cancer of the ampulla, 32 with cancer of the head, 13 with cancer of the body and four with cancer of the entire pancreas, are the subjects of the survival study. They consisted of 13 patients with group 1, ten with group 2, nine with group 3

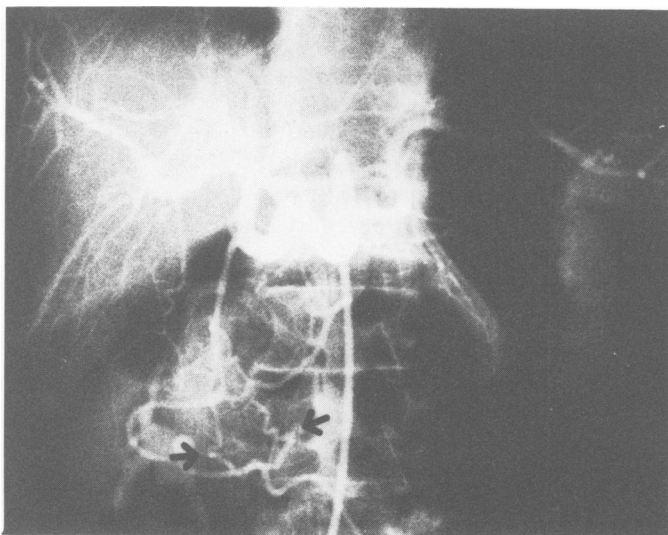


FIG. 1. Angiogram of the celiac trunk in a patient in group 1 (cancer of the head of the pancreas). Invasion by the tumor is confined to the pancreaticoduodenal arteries (arrows).

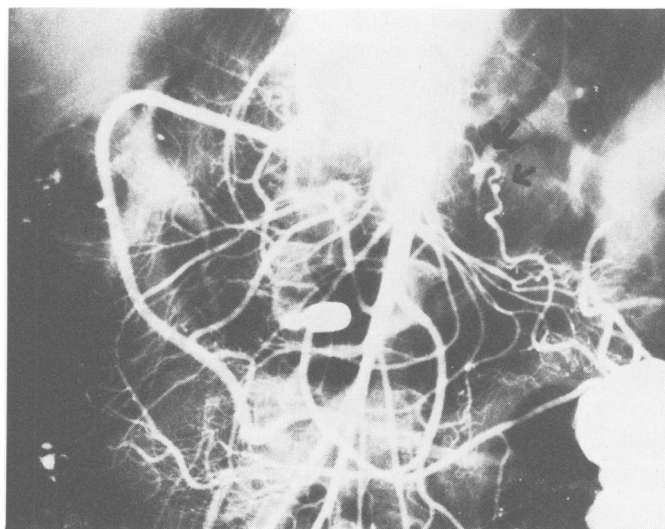


FIG. 3. Angiogram of the superior mesenteric artery in a patient in group 3 (cancer of the body of the pancreas). Invasion by the tumor extends farther into the middle colic artery (arrows).

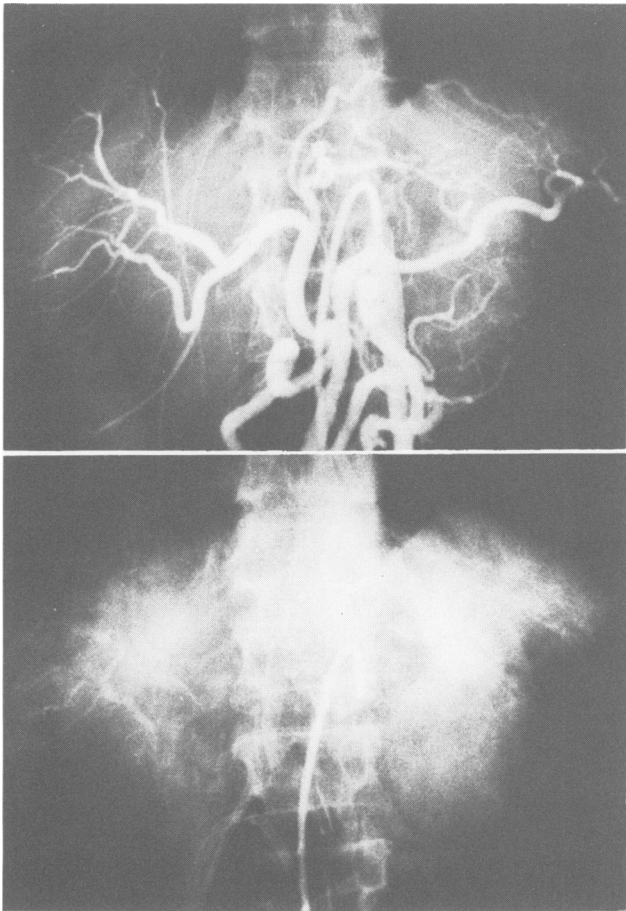


FIG. 4. Angiogram of the celiac trunk in a patient in group 4 (cancer of the body of the pancreas associated with liver metastasis). A (top) Arterial phase. The splenic artery is encased by the original lesion in the pancreas. B (bottom). Capillary phase. Retarded opacifications with contrast medium are seen in the metastatic lesions of the liver.

and 22 with group 4. The average survival time of each group after arteriography was as follows. Group 1 cancer had an average survival time of 16.8 months, group 2 had 4.8 months, group 3 had 3.5 months and group 4

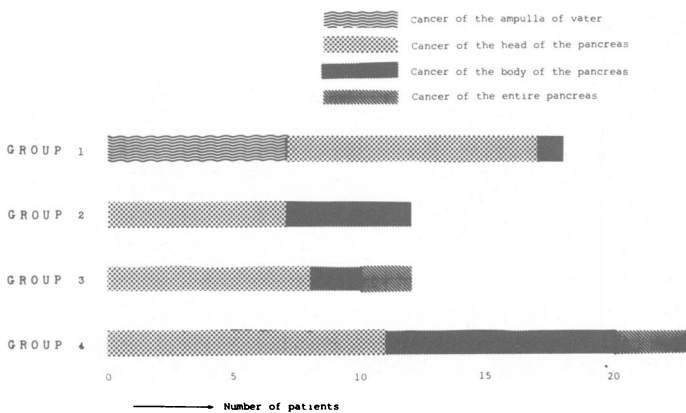


FIG. 5. Distribution of 65 patients with cancer of the pancreas by group and location of the lesion.

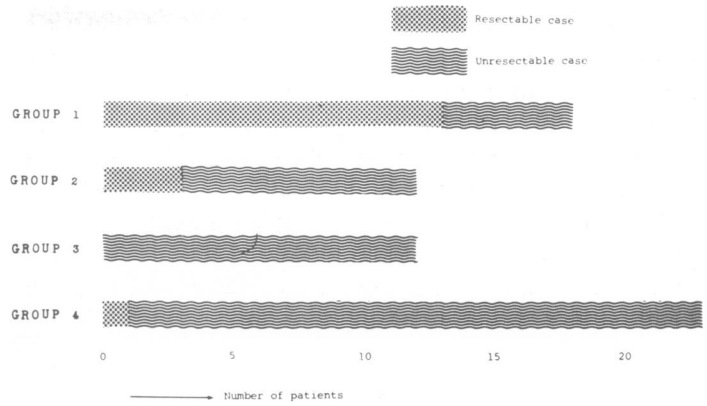


FIG. 6. Resectability of the lesions in each group of patients.

had 2.4 months (Fig. 7). Figure 8 shows survival curves in each group of patients. Five patients with resectable cancer of the ampulla, all of whom belonged to group 1, showed an average survival time of 25.3 months (Fig. 9). Of five patients with resectable cancer of the head, three were in group 1 and the other two were in group 2. The former showed the mean survival time of 19.6 months, while the latter that of 7.9 months. Of 27 patients with unresectable cancer of the head, four belonged to group 1, five to group 2, seven to group 3 and 11 to group 4. The average survival time of these unresectable group 1 cancers was 7.7 months; that of group 2, 4.2 months; that of group 3, 3.8 months and that of group 4, 1.6 months (Fig. 10). Two with resectable cancer of the body showed an average survival time of 3.6 and 4.2 months, respectively. Of 11 with unresectable cancer of the body, one belongs to group 1, two to group 2, one to group 3 and seven to group 4. The average survival time of each group of these patients accounted for 2.6, 3.7, 2.4 and 1.8 months, respectively (Fig. 11). Four patients with cancer of the entire pancreas consisted of one with group 3 and three with group 4. The former showed survival time of 2.7 months and the latter showed that of 2.2 months (Fig. 12).

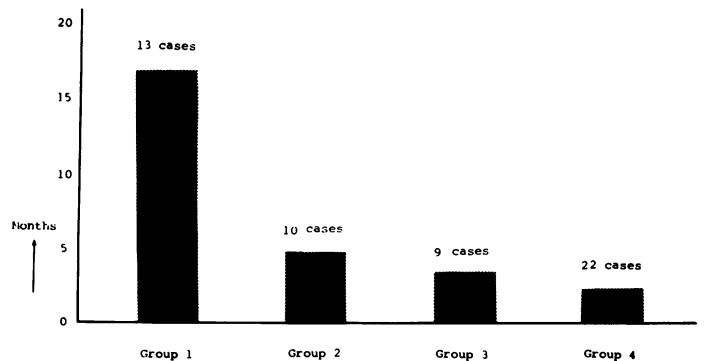


FIG. 7. Survival from time of arteriography in each group of patients.

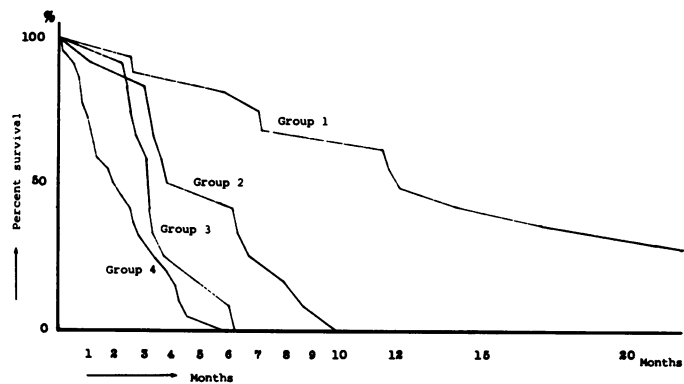


FIG. 8. Survival curves in each group of patients. Abscissa shows months after the time of arteriography.

Discussion

The diagnostic value of selective arteriography for cancer of the pancreas has been extensively studied by a number of investigators, but no reports discussed the prognostic significance of this diagnostic procedure. This study is an extension of our previous investigation³ on the relationship of the arteriogram to resectability in cancer of the pancreas. In that study, it was found that the lesion in which infiltration of the tumor into the vessel is confined to the anterior superior pancreaticoduodenal artery or the duodenal branches of the pancreaticoduodenal arteries, can certainly be resected; that in which infiltration of the tumor into the vessel is confined to two of four pancreaticoduodenal arteries, may probably be resectable; that in which the dorsal pancreatic artery or three or all of four pancreaticoduodenal arteries are invaded, can be scarcely resected; that in which neoplastic invasion extends into the gastroduodenal artery or other arteries adjacent to the pancreas, fails to be curatively resectable; and radical resection for cancer of the body of the pancreas is extremely difficult even in patients in whom vascular invasion is angiographically confined to the intrapancreatic arteries.

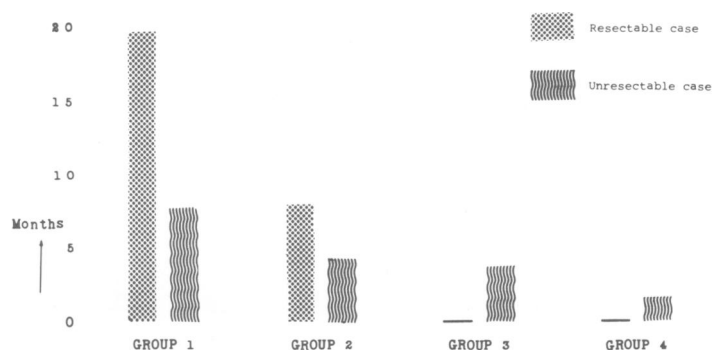


FIG. 10. Average survival time of each group of patients with cancer of the head of the pancreas (32 cases).

Many reports on the survival time of patients with cancer of the pancreas have not included the detailed information about the size or extension of the lesions. This may be partly due to the extension of the lesions in the pancreas which can not be accurately seen on the usual examinations. Even with the meticulous palpation at the time of laparotomy, precise estimation of the cancerous area can not always be determined because of co-existing fibrosis or inflammatory change in the surrounding pancreas tissues. According to our microangiographic studies which use the resected specimen, the cancerous portion in the pancreas is mostly hypovascular, but invasion of the arterial wall visualized on the film fairly correctly reflected the area of the cancerous lesion. Thus, arteriography is considered to be one of the most reliable indices to indicate the extent of the tumor of the pancreas.

Anatomically, unlike the liver, spleen and kidney, the pancreas has no independent artery. It is supplied with the various branches of the celiac trunk and superior mesenteric artery. In this study, a number of arteries related to the pancreas were classified into the following three kinds: the arteries confined to the pancreas, the arteries adjacent to the pancreas and the arteries of the extrapancreatic organs. Based on the grade of invasion by the tumor into these kinds of arteries, cancer of the pancreas was angiographically divided into four

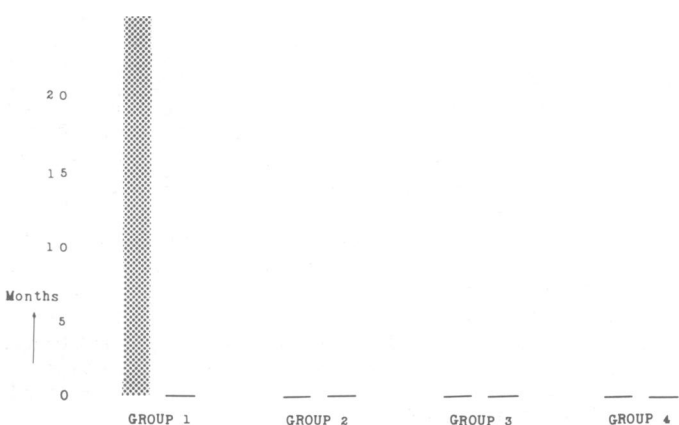


FIG. 9. Average survival time of patients with cancer of the ampulla of Vater (five cases). The lesions are all resectable.

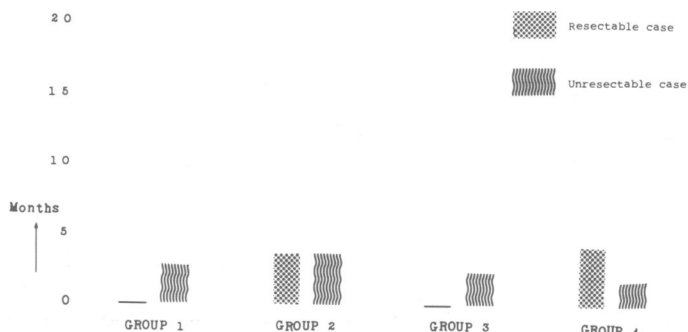


FIG. 11. Average survival time of each group of patients with cancer of the body of the pancreas (13 cases).

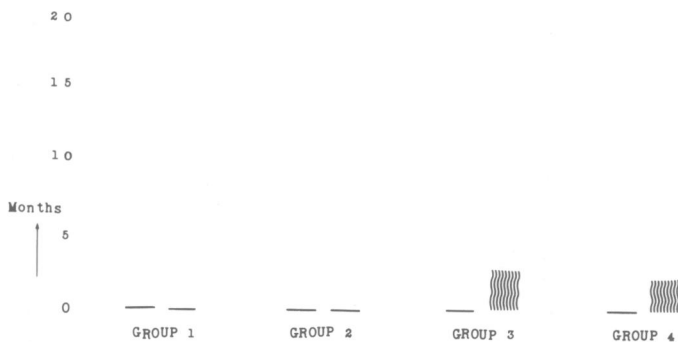


FIG. 12. Average survival time of patients with cancer of the entire pancreas (four cases). The lesions are all unresectable.

groups. Except for patients with cancer of the body of the pancreas, correlation between the arteriogram and survival distinct enough to permit surgical conclusions was demonstrable among each group of cancer. Group 1 cancer, in which invasion by the tumor was angiographically confined to the intrapancreatic arteries, showed the highest percentage of resectable cases and the longer survival period, even after the palliative treatment. In other groups of patients, markedly unfavorable prognosis was shown. It is presumed that recurrence of the tumor shortly after resection may be unavoidable, when infiltration of the lesion is radiologically demonstrated in the peripancreatic arteries such as the gastroduodenal and splenic arteries. The poorest prognosis was revealed in the patients with group 4, whose average survival time accounted for only 2.4 months. Jaffe¹ reviewed the median survival time of the patients with metastatic liver cancer. According to his results, the survival time of those with liver metastasis from colonic cancer was 146 days and that from gastric cancer was 60 days. On the other hand, those with liver metastases from the biliary tract and pancreas showed only 42 days of median survival. Any treatment, such as chemotherapy or irradiation will presumably be ineffective for patients with group 4 disease. It is of prime importance, for those with cancer of the pancreas, to attempt active treatments during the stage when the tumor is yet confined to the intrapancreatic tissue. To patients in group 1, infusion chemotherapy should be applied, even if the lesion is unresectable. With respect to effect of chemotherapy on patients with cancer of the pancreas, much remains to be explained. As previously described, our microangiographic studies indicate that blood flow in the usual type of cancer of the pancreas is mostly reduced. Therefore, anticancer drug administered either intravenously or orally may fail to have an effective contact with the cancerous tissue of the pancreas. As suggested by Klopp,² direct infusion of the drug into the tumor-supplying artery is considered to be effective. However, placement

of the infusion catheter into the pancreatic arteries at the time of laparotomy is often difficult, because the lesion is apt to invade and enclose the vessels of the pancreas. For such patients, we have attempted implantation of the infusion catheter into the tumor-supplying artery by means of the percutaneous double catheters technic.⁴ Further studies are being pursued to determine the effect of this form of chemotherapy on each group of patients with cancer of the pancreas.

Summary

The relationship between preoperative arteriograms and survival time of patients with adenocarcinoma of the pancreas was studied. The arteries related to the pancreas were divided into three kinds—the arteries confined to the pancreas, the arteries adjacent to the pancreas and the arteries of the extrapancreatic organs. Based on the grade of invasion by the tumor into these kinds of arteries, 65 patients were angiographically classified into four groups. Except for patients with cancer of the body of the pancreas, positive correlation between each group of the patients and their survival time was shown. Group 1 cancer in which the invaded arteries were radiologically limited to those confined to the pancreas showed the highest percentage of resectable cases and the longer survival period, even after palliative treatment. For these patients, chemotherapy probably has much to offer. In patients with group 2 and 3 disease in whom invasion by the tumor extended into the extrapancreatic arteries, prognosis became markedly unfavorable. In these groups, recurrence of the tumor will occur shortly after operation, despite active treatment. The poorest prognosis was shown in patients with group 4 disease in whom liver metastasis was associated, irrespective of the size of the original lesion. It is of prime importance to attempt active treatment during the stage in which arteriography shows the tumor to still be confined to the intrapancreatic tissue.

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