Current Status of Transcatheter Management of Neoplasms

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Abstract. Transcatheter arterial infusion and arterial embolization are employed in the treatment of various neoplasms. In patients with carcinoma of the colon metastatic to the liver, the hepatic arterial infusion (HAI) of flouxuridine and MitomycinC produced a 55% partial response and a 12% complete response, as well as an improved median survival of 18 months. In metastatic breast carcinoma, a 30% response was achieved. In some cases, proximal embolization of aberrant hepatic arteries was performed to redistribute the hepatic flow to a single vessel to assist infusion of the entire liver using a single catheter. Devascularization by hepatic artery embolization has also been used to treat hepatic neoplasms. Arterial occlusion of renal carcinoma, followed after four to seven days by nephrectomy and hormonal therapy, produced a 36% response rate in 49 patients with distant metastases. In 14 patients with osteosarcoma treated with cis-diaminedichloroplatinum (CDDP) arterial infusion, a 57% response rate was achieved. Benign bone tumors were treated with arterial occlusion with a 60% response rate. Tumors of the pelvis were managed by bilateral internal iliac artery infusion using CDDP. In 21 patients with recurrent bladder carcinoma, control of pain and hematuria and prolonged survival were achieved.

Key words: Arterial infusion – Arterial embolization – Hepatic neoplasm – Renal carcinoma – Osteosarcoma – Bladder carcinoma – Interventional angiography.

The futility of existing therapy for certain neoplasms has stimulated exploration into interventional radiologic techniques. Many interventional procedures that were initially performed out of desperation have now been incorporated into primary therapeutic management. Of the 100 angiographic examinations performed each month at M.D. Anderson Hospital and Tumor Institute (MDAH), about 60% are interventional. Although 10 to 15 arterial embolizations are performed each month, the percutaneous transcatheter intraarterial infusion of chemotherapeutic agents accounts for the majority of the interventional procedures. With the advent of superselective catheterization, newer chemotherapeutic agents, and a higher dose-time relationship, the intraarterial infusion technique has been resurrected in an attempt to improve the survival of patients with selected hepatic neoplasms. In addition, the use of intraarterial infusion has been extended to tumors at other sites, including the musculoskeletal system and the genitourinary tract.

Arterial embolization and occlusion have been effective in the treatment of renal carcinoma, primary and secondary hepatic neoplasms, and benign and malignant bone tumors. The indications for transcatheter embolization of neoplasms are: (1) to control hemorrhage; (2) preoperatively, to facilitate resection by decreasing blood loss and operating time; (3) to inhibit tumor growth; (4) to relieve pain; and perhaps (5) to stimulate an immune response to the ischemic neoplasm. These contributions and other potential applications of interventional radiology to the therapeutic management of patients with certain neoplastic diseases will be described.

Liver

The liver is the major organ most frequently involved by metastatic disease. Hepatic metastases rather than the primary neoplasms usually govern the course of
the disease and the patient's survival. The median survival duration for patients with untreated liver metastases from carcinoma of the colon is 150 days; from carcinoma of the stomach, 60 days; and from carcinoma of the pancreas, 50 days [1]. In view of this ominous prognosis, an aggressive therapeutic approach is justified.

The transcatheter management of hepatic neoplasms, whether primary or secondary, includes arterial infusion and occlusion. Hepatic arterial infusion (HAI) of chemotherapeutic agents is a viable treatment alternative if the disease is localized in the liver, especially if systemic therapy has failed. The presence of aberrant vessels may necessitate redistribution of hepatic arterial supply by the intentional occlusion of certain vessels to allow optimal delivery of chemotherapeutic agents through a single artery. Peripheral embolization alone or in combination with central occlusion of the hepatic artery is frequently performed if the patient fails to respond to HAI or if effective drugs are not available. Our interventional angiographic approach to the liver is outlined in Figure 1. It should be stressed that if a hepatic neoplasm is localized to a resectable segment, then surgery is still the treatment of choice.

**Hepatic Arterial Infusion**

Patients with hepatic metastases from colorectal carcinoma have a median survival of five months (with a range as long as two years from the time of diagnosis); intravenous chemotherapy extends the median survival to one year. Liver metastases refractory to systemic chemotherapy may respond to HAI [2]. The rationale for HAI is based on the observation that most antitumor agents have a steep dose-response curve; that is, the higher the concentration of the drug, the greater the antitumor effect and the greater side effects [3]. Since 90-95% of the blood supply to the hepatic neoplasm, primary or secondary, originates from the hepatic artery, administration of drugs by HAI exposes the tumor to higher drug concentrations while keeping the side effects to a minimum [4-6].

Currently, a combination of mitomycin C (MTC) and floxuridine (5-FUDR) is delivered by HAI to hepatic metastases from colorectal cancer. Both drugs are metabolized by the liver. The 5-FUDR was selected over 5-fluorouracil (5-FU) because of the higher extraction of 5-FUDR by the liver, which makes possible a shorter course of therapy (five days) [6].

**Catheterization Technique.** A high brachial or axillary arterial approach is preferred for an infusion continuing for five days because it allows the patient greater mobility, while for infusions of 24 hours or less, the femoral route is used. From a high brachial artery puncture, a 90–100 cm 5 French polyethylene catheter is placed into the hepatic artery; from the femoral artery, a 65 cm (5 or 6.5 French) catheter is used. A down-going celiac artery, frequently seen in an enlarged liver, is more readily catheterized from the brachial artery while an up-going celiac artery is best approached from a femoral puncture. The proper hepatic artery is the ideal site for catheter placement, when technically feasible. With reversed (hepatopetal) flow in the gastroduodenal artery, which is seen more frequently with hypervascular metastases, placement of the catheter in the common hepatic artery is adequate. Superselective catheterization with placement in the desired hepatic vessel is accomplished in at least 90% of patients.

**Infusion Technique.** The catheter is connected to a pump (e.g., McGraw or Sigmamotor) for continuous infusion of chemotherapeutic agents. The catheter is fixed in place by the use of a plastic adhesive covered by soft surgical tape. To minimize thrombotic complications, 10,000–25,000 units per day of aqueous heparin are administered via HAI or intravenously (IV) to achieve and maintain a one and one-half-fold prolongation of the partial thromboplastin time (PTT). Heparin is incompatible with certain chemotherapeutic agents, such as adriamycin, and must therefore, be administered separately by IV while the adriamycin is being given by HAI. Aspirin, 650 mg, is dispensed orally twice a day beginning 24 hours before catheterization.

A conventional roentgenogram of the abdomen is taken daily to check the catheter position. In the event of catheter displacement during the treatment

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1 Op-Site, Smith & Nephew Inc., Lachine, Quebec, Canada
2 Microfoam, 3M Company, St. Paul, MN 55101, USA