Utility of CT during Arteriography in Superselective Transarterial Chemoembolization for Invasive Bladder Cancer

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Background & Aims: To assess the effectiveness of CT during arteriography (CTA) in superselective transarterial chemoembolization (TACE) for invasive bladder cancer, and to report preliminary results of superselective TACE. Methods: Angiography was performed in 20 patients with invasive bladder cancer, using a combined CT-Angiography system. Of the 20 tumors, 19 were T3, one was T2. The vesical arteries were selected using a 3F microcatheter, and perfusion was confirmed using CTA. TACE was performed after administering 40 to 100 mg of cisplatin, with and without gelatin sponge particles. The effects of TACE were assessed by surgery or a combination of cystoscopy and CT in 15 cases. Results: The vesical arteries were successfully selected in 18 of 20 patients. In 16 small tumors, the tumor stain was clearly depicted on CTA. In two large tumors, the vascular supply was identified as involving multiple arteries. One case showed complete remission, six showed partial remission, and eight showed no change. Complications included mild local pain around the perineum during TACE, and transient nausea in some patients. Conclusion: CTA may be useful in superselective TACE for invasive bladder cancer, and may contribute to effective treatment of bladder tumors. (Kitakanto Med J 2004 ; 54 : 81~86)

Key words: bladder cancer, CT angiography, chemoembolization

Introduction

The treatment of bladder cancer varies according to the tumor staging.1,2 Patients with superficial bladder cancer are generally treated with transurethral resection followed by intra-vesical chemotherapy and have a relatively good prognosis. Patients with more invasive, but still localized tumors (T2, T3) are candidates for more aggressive local treatment, including partial or radical cystectomy, irradiation or a combination of surgery and systemic chemotherapy. Some patients receive intra-arterial chemotherapy, followed by radiation therapy or radical cystectomy. The rationale for intra-arterial infusion of chemotherapeutic agents is the increased dosage delivered to the tumor with reduced toxicity. Intra-arterial chemotherapy for invasive and locally advanced bladder cancer has been evaluated at many centers with various results.3~6

Computed tomography (CT) is widely used in the diagnosis of numerous diseases. Recently, in the management of hepatocellular carcinoma, the high tumor detection capacity of CT during arterial portography has facilitated preoperative assessment of patients scheduled for hepatectomy.7~10 CT during arteriography (CTA) is capable of evaluating the vascularity of lesions, and improves tumor detectability.

Recently, a combined CT-Angiography system was developed11 and is now employed as the most appropriate method of transcatheter treatment of hepatocellular carcinomas as well as for preoperative examination. We applied this CTA system to intra-arterial chemotherapy of bladder cancer, in order to target the vesical artery which feeds bladder cancer, and in this

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Effectiveness of CT during arteriography

We will describe the effectiveness of CTA in superselective transarterial chemoembolization (TACE) for invasive bladder cancer.

Materials and Methods

Between December, 1999 and November, 2000, 20 patients with invasive bladder cancer were examined by digital subtraction arteriography (DSA). The patients included 12 males and eight females, ranging in age from 45 to 86 years (mean 68 years). CT revealed that 19 patients had T3 (thickening of bladder wall around the tumor), and one patient had a T2 (tumor without thickened wall) tumor. The tumor size ranged from 15mm to 60mm (mean 37mm).

TACE was performed using the following procedures. A 4-french short sheath was inserted into the opposite side of bladder cancer. Aortography was performed using a pigtail catheter and pelvic arterial branching was observed. The internal iliac artery was selected with a cobra shaped catheter and anterior-posterior and anterior medial oblique views were obtained. Anterior medial oblique views, usually 30°, showed branches of the internal iliac artery in most patients and the superior and inferior vesical arteries were also identified. A 3-french Microferret microcatheter (William Cook Europe, Bjaeverskov, Denmark) and a hydrophilic polymer-coated, 0.016-inch guide wire (GT wire, Terumo, Tokyo) were used in the superselection of vesical arteries.

A combined CT-Angiography system (AG-CT Miyabi, Siemens Medical Systems, Iselin, NJ) was used for CTA. Helical CT scans were obtained at the level extending from the sacroiliac articulation to the perineum by using a 5mm collimation and a table speed of 5mm (pitch of one). Iodine contrast material (iomeprol, Iomeron 350, Eisai, Tokyo) was injected manually at the vesical artery. CT scanning was generally initiated 5 seconds after the injection of iodine contrast material. The bladder was filled with physiological saline through a urethral catheter during the scan.

When the tumor was detectable on CTA from the selected vessels, cisplatin was slowly infused, usually for about 30 minutes, using a mechanical injection pump. The cisplatin dosage was 40mg to 100mg, depending on the patient’s weight, complaints, catheter tip location, and lumen size. In the case of large tumors supplied by two or more vesical arteries, cisplatin was separately administered. Finally, in 13 patients the vesical arteries, which had been infused with cisplatin, were embolized with a small amount of gelatin sponge particles. In five patients, TACE was performed two or three times. Tumors involving the bilateral bladder wall were approached through the bilateral femoral arteries.

The effects of TACE were assessed by surgery or a combination of cystoscopy and CT one month after TACE. Complete disappearance of bladder cancer was defined as complete remission, a decrease in tumor size exceeding 50 percent as partial remission, a decrease of less than 50 percent or an increase in tumor size exceeding 25 percent as no change, and an increase of more than 25 percent as progressive disease. The effects of TACE were evaluated by two radiologists (J. A., A.I.) and a urologist (M.I.), based on consensus.

Results

The vesical arteries were identified and successfully selected using a microcatheter in 18 of 20 patients. In one patient, the internal iliac arteries were completely occluded due to severe arteriosclerosis and in another, the vesical arteries were technically difficult to mi-

Fig. 1 Angiography of the superior vesical artery.
A. DSA of the left superior vesical artery. No tumor stain is detectable.
B. CTA of the left superior vesical artery. Tumor staining is clearly depicted on the anterior wall of the bladder (arrow).
Crocatheterize.

Anteroposterior views facilitated detection of the vesical artery. Some cases clearly showed the origin of the vesical artery that fed the bladder tumor. An anterior medial oblique view demonstrated the origin of each branch in most cases to be the proximal

Fig. 2 Angiography of the uterine artery.
A. DSA of the left uterine artery. No tumor stain is detectable on vesical arteries and examined via the uterine artery.
B. CTA of the left uterine artery shows enhancement on the left side of the uterus (arrow) and a very small tumor stain (arrow head).

Fig. 3ABC CT angiography of the bladder tumor.
CTA shows each region of the diffuse bladder cancer fed by multiple vesical arteries.
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However, stains of small tumors (16/18) were not sufficiently visible on DSA, while CTA clearly revealed the tumor (Fig. 1A, B). In several cases, the internal pudendal, uterine, vesicular, and vaginal arteries were difficult to distinguish from the vesical artery. In such cases, CTA precisely depicted the area of contrast enhancement through superselected arteries (Fig. 2A, B).

In two large tumors, vascular supply was demonstrated to involve multiple arteries based upon routine angiography and CTA facilitated the confirmation of the feeding area of each vesical artery (Fig. 3A, B, C).

The inferior vesical artery was often found to feed the prostate and superior portion of the urethra on CTA (Fig. 4).

After these CTA findings had been obtained, appropriate TACE was performed in all 18 cases in whom vesical arteries were successfully selected (Table 1). The effects of TACE were assessed in 15 cases. Complete remission was observed in one case (Fig. 5), partial remission in six, and no change in eight. No cases showed progressive growth of the tumor.

No definitive effect of embolization using gelatin sponge particles was obtained. Four (22%) patients complained of mild local pain around the perineum during cisplatin injection but medication was not necessary. Seven (39%) patients experienced transient nausea after TACE. There were no severe complications, such as the dysfunction of the liver or kidneys and myelosuppression.

Discussion

The branching of the internal iliac artery frequently manifests wide variations. Blood is supplied to the urinary bladder through the superior and inferior vesical arteries which are very thin and show several branching variations. The umbilical artery most often arises from the internal iliac artery just distal to the origin of the superior gluteal artery. Thus, injection of iodine contrast material into the internal iliac artery just distal to the superior gluteal artery facilitates detection of the umbilical artery. One to three superior vesical arteries arise from the umbilical artery. Therefore, injection of iodine contrast material from the origin of the umbilical artery demonstrates all

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**Table 1 Patient characteristics**

<table>
<thead>
<tr>
<th>Patient No</th>
<th>Sex</th>
<th>Age</th>
<th>T&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Embolization&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Effects of TACE&lt;sup&gt;c&lt;/sup&gt;</th>
<th>3 Year Survival</th>
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<td>72</td>
<td>3</td>
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<tr>
<td>3</td>
<td>F</td>
<td>79</td>
<td>3</td>
<td>×</td>
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<td>4</td>
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<tr>
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<td>75</td>
<td>3</td>
<td>×</td>
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<td>F</td>
<td>75</td>
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<td>7</td>
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<tr>
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<td>M</td>
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<td>×</td>
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<tr>
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<td>18</td>
<td>F</td>
<td>80</td>
<td>3</td>
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<td>NC</td>
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<sup>a</sup> T; T classification  
<sup>b</sup> ○; embolized with gelatin sponge particles. ×; embolization was not performed.  
<sup>c</sup> CR; complete remission. PR; Partial remission. NC; no change. *; not evaluated

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Fig. 4 CT angiography of the inferior vesical artery. Prostate gland enhancement is seen through CTA of the inferior vesical artery, showing that the inferior vesical artery feeds the lower urinary tract.
superior vesical arteries. The inferior vesical artery arises from the umbilical artery, or directly from the distal branches of the internal iliac artery. Some arteries, such as the prostatic, uterine, vesicular, vaginal, and middle rectal arteries, mimic the vesical arteries in arteriography making it difficult to obtain anatomic information by conventional angiography without CTA.

Small or flat bladder cancers did not show enough staining to be detected through routine angiography. In contrast, CTA showed the exact distribution of the contrast material injected via a selected artery and the tumor stain was clearly seen in all cases. In 13 patients, after transarterial infusion of cisplatin, embolization was carried out with gelatin sponges. As the bladder tumor was not always hypervascular and some vesical arteries were thin, a large amount of embolization material was not necessary. Gelatin sponge particles are material used for temporal embolization. The vesical artery is embolized in the first TACE and is thus already open at the second or the third TACE. The effect of embolization of the vesical artery after infusion of carcinostatic compounds remains to be determined.

Four patients (22%) complained of mild local pain around the perineum during cisplatin injection. The inferior vesical artery often feeds the area of the upper region of the urethra, resulting in chemical stimulation by cisplatin around the perineum. Superselective embolization of the branches around the urethra prior to cisplatin infusion may allow local pain around the perineum to be avoided.

Although long-term results of TACE were not fully investigated, injection of a carcinostatic agent through the internal iliac artery has been reported to be effective for the treatment of invasive bladder cancer. These studies were performed using DSA, but we employed a newly developed system combining of CT and DSA, which allowed us to obtain CT scans during selective angiography. We could appropriately modify the distribution of an intra-arterially injected drug for chemoembolization. CTA may also provide additional information regarding anomalous arterial branching, and parasitic blood supply to the tumor.

Superselective injection into the vesical artery can concentrate a carcinostatic agent, thereby making infusion of that agent around the bladder unnecessary. Our preliminary study indicates CTA to possibly be useful in superselective TACE for invasive bladder cancer, and contribute to effective tumor treatment.

References


