Transfemoral intra-arterial chemotherapy for head and neck cancer using a 3-French catheter system: Comparison with a 4-French catheter system

Shigeru WATANABE, Akira YAMAMOTO, Teruyuki TORIGOE, Akihiko KANKI, Hiroki HIGASHI, Tsutomu TAMADA, Katsuyoshi ITO

Department of Diagnostic Radiology, Kawasaki Medical School
577 Matsushima, Kurashiki, 701-0192, Japan

ABSTRACT  To assess the technical feasibility of transfemoral intra-arterial chemotherapy for head and neck cancer by using a 3-French catheter system and evaluate the safety of shortening the bed rest time with this technique.

Sixty-two patients with head and neck cancer who underwent transfemoral intra-arterial chemotherapy were included in this study. Thirty-three patients (30 men, 3 women; mean age, 65.7 years: range, 47-80 years) underwent treatment using a 3-French catheter system (Group 3-Fr). Twenty-nine patients (21 men, 8 women; mean age, 65.8 years: range, 47-78 years) underwent treatment using a 4-French catheter system (Group 4-Fr). The technical success rate, duration of the procedure with fluoroscopy, and rate of procedure-related complications were compared between Group 3-Fr and Group 4-Fr. In addition, in Group 3-Fr, bleeding at the puncture site after 1.5 h of bed rest was evaluated to confirm the safety of shortening the bed rest time.

The technical success rate was 100% in both Group 3-Fr and Group 4-Fr. The duration of the procedure with fluoroscopy did not differ between Group 3-Fr (mean, 28.0 min; range, 4.5-77.4 min) and Group 4-Fr (mean, 30.2 min; range, 9.6-79.0 min) (P = 0.524). There was no procedure-related complication in either group. In Group 3-Fr, no hemorrhagic complication was observed at the puncture site after 1.5 h of bed rest.

Transfemoral intra-arterial chemotherapy for head and neck cancer using a 3-French catheter system was as safe as using a 4-French catheter system, and the treatment was technically feasible, with approximately same the duration of the procedure with fluoroscopy. The 3-French catheter system made it possible to shorten the bed rest time without hemorrhagic complications, and it is expected to reduce the risk of pulmonary embolism.

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Key words : 3-French catheter system, Intra-arterial Chemotherapy, Head and neck cancer
INTRODUCTION

Chemoradiation is one of the therapeutic strategies for advanced unresectable head and neck cancer. Intra-arterial high-dose chemotherapy for head and neck cancer has been studied for several years, and reports of this technique were promising, with an initial local control rate of approximately 90% in addition to minimization of systemic side effects. The transfemoral approach is regarded as a first-line approach for intra-arterial chemotherapy for head and neck cancer due to the anatomical structure of the artery. This approach requires bed rest with compression of the puncture site after the procedure to prevent hemorrhagic complications at the puncture site. However, the necessity of prolonged compression of the puncture site and bed rest is a great disadvantage to patients that carries the risk of pulmonary embolism.

Recent developments of catheter devices have improved the simplicity and safety of interventional procedures. Downsizing the devices may decrease the risk of hemorrhagic complications and shorten the durations of puncture site compression and bed rest. Concerning interventions for abdominal lesions, a few reports revealed the technical feasibility and safety of shortening the bed rest time using a 3-French catheter system. Regarding interventions for head and neck lesions, a few reports assessed neuroangiography using a 3-French catheter. However, no studies investigated intra-arterial chemotherapy for head and neck cancer using a 3-French catheter system. The purposes of this study were to assess the technical feasibility of transfemoral intra-arterial chemotherapy for head and neck cancer using a 3-French catheter system and evaluate the safety of shortening the bed rest time with this technique.

MATERIALS AND METHODS

Patients

This retrospective study was approved by the institutional review board, and the requirement for informed consent was waived. Sixty-two patients with head and neck cancer who underwent transfemoral intra-arterial chemotherapy in our institution from April 2009 to April 2011 were included in this study. The platelet counts of all patients were within the normal range. Thirty-three patients (30 men, 3 women; mean age, 65.7 years: range, 47-0 years) underwent the procedure using a 3-French catheter system (Group 3-Fr). Twenty-nine patients (21 men, 8 women; mean age, 65.8 years: range, 47-78 years) underwent the procedure using a 4-French catheter system (Group 4-Fr). The head and neck cancers included 7 maxillary sinus cancers, 6 maxillary sinus cancers, 11 oral cavity cancers, 11 oropharyngeal cancers, 10 hypopharyngeal cancers, 11 laryngeal cancers, and 15 laryngeal cancers. The patient characteristics are presented in Table 1.

Device specifications

The 3-French catheter system comprised a 3-French sheath introducer (Super-Sheath; Medikit, Tokyo, Japan) that is able to insert a 3.5-French angiographic catheter (Fansac 4; Terumo Clinical Supply, Gifu, Japan) and a 0.032-inch hydrophilic guidewire (Radifocus Guidewire M; Terumo, Tokyo, Japan). The 4-French catheter system comprised a 4-French sheath introducer (Super-Sheath; Medikit) that is able to insert a 4.2-French angiographic catheter (Fansac 4; Terumo Clinical

<table>
<thead>
<tr>
<th>Table 1 Patient characteristics</th>
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<tbody>
<tr>
<td>No. of patients</td>
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<tr>
<td>Mean age, years (range)</td>
</tr>
<tr>
<td>Male/Female</td>
</tr>
<tr>
<td>Tumor site</td>
</tr>
<tr>
<td>Maxillary sinus</td>
</tr>
<tr>
<td>Oropharynx</td>
</tr>
<tr>
<td>Oral cavity</td>
</tr>
<tr>
<td>Hypopharynx</td>
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<tr>
<td>Larynx</td>
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Supply) and a 0.035-inch hydrophilic guidewire (Radifocus Guidewire M; Terumo). Microcatheters such as 2.0 / 2.4-Fr microcatheter (Wonder 3; UTM, Aichi, Japan) and 0.014-inch hydrophilic micro-guidewire (Chikai V; Asahi Intecc, Aichi, Japan) were commonly used both systems. The details of the catheter systems are shown in Table 2.

**Intra-arterial chemotherapy procedure**

Angiographic procedures were common in Group 3-Fr and in Group 4-Fr. All catheterizations were performed via the common femoral artery (mainly the right common femoral artery). The puncture site was determined by fluoroscopy at the level of the femoral head. The skin at the puncture site was infiltrated with 1% lidocaine, and the common femoral artery was punctured. A J-tipped guidewire was inserted through the plastic cannula. The guidewire was carefully advanced up the femoral artery, through the iliac arteries, and into the abdominal aorta under fluoroscopic guidance. The sheath introducer was advanced over the guidewire into the abdominal aorta, and then the dilator and guidewire were removed. After the sheath was inserted, the patients received 3,000 U of heparin intravenously with a boost of 1,000 U of heparin administered every hour. The angiographic catheter was used as the parent catheter with a regular angle guidewire. The parent catheter was forcefully irrigated with heparinized saline (2,000 U of heparin per 500 mL of saline) through the Y-Connector (Anplast-C; Terumo, Tokyo, Japan). The parent catheter was advanced over the guidewire into the ascending aorta, and the parent catheter was turned over and pulled back to select the brachiocephalic or common carotid artery. To prevent kinking of the parent catheter, the relationship between the guidewire and catheter was maintained during the process of selecting target vessels. External carotid arteriography and/or common carotid arteriography using nonionic contrast medium (Visipaque® 270; Daiichi Sankyo, Tokyo, Japan) was performed (6-8 mL at 3-5 mL/s via the parent catheter). If the feeding arteries could be identified, a microcatheter was placed carefully in the feeding artery with microguidewire assistance. Docetaxel (40 mg/m²) was injected into the feeding artery for 30 min via the catheter. After intra-arterial chemotherapy was administered, hydrocortisone (100 mg) was delivered into the artery via the catheter. All examinations were performed using a digital subtraction biplane image intensifier or flat-panel systems (Infinix VB; Toshiba Medical Systems, Tokyo, Japan or Allura Xper FD 20/10; Philips Medical Systems, Best, The Netherlands) (Fig. 1).

After the intervention, the effects of heparin were reversed with Novo-Protamine Sulfate (15-20 mg). After Novo-Protamine Sulfate was administered, the sheath was removed, and the puncture site was compressed manually for 5 min. If hemostasis was achieved, then the puncture sites were compressed with bandages, and the patients were then confined to bed rest and instructed to keep the punctured leg extended. The bandages were removed after 1.5 h of bed rest for Group 3-Fr and after 4-12 h of bed rest for Group 4-Fr, and the patient was allowed to start ambulation thereafter. The puncture site was periodically inspected by the ward nurse.

<table>
<thead>
<tr>
<th>Table 2 Details of the devices</th>
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<tr>
<td><strong>3-Fr system</strong></td>
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<tr>
<td>Device</td>
</tr>
<tr>
<td>3-Fr sheath introducer</td>
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<tr>
<td>3.5-Fr catheter</td>
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<tr>
<td>Guidewire</td>
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<td>2.0 / 2.4-Fr microcatheter (outer diameter: 0.67 mm / 0.80 mm) and 0.014-inch (outer diameter: 0.36 mm) hydrophilic micro-guidewire were commonly used both systems.</td>
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Data analysis

Technical success was defined as insertion of a microcatheter selectively to all intended arteries for intra-arterial chemotherapy in a treatment session. The technical success rate was calculated and compared between Group 3-Fr and Group 4-Fr.

The duration of the procedure with fluoroscopy and the procedure-related complication rate were also compared between Group 3-Fr and Group 4-Fr. In addition, in Group 3-Fr, bleeding at the puncture site after 1.5 h of bed rest and ambulation was evaluated to confirm the safety of the reduced bed rest time.

An unpaired Student’s t-test was used to determine significant differences in the duration of the procedure with fluoroscopy between Group 3-Fr and Group 4-Fr. Statistical analyses were performed using SPSS version 17.0 J for Windows software. All tests were 2-sided, and P < 0.05 was considered statistically significant unless otherwise specified.

RESULTS

Catheterization was successfully performed in all 62 patients. The technical success rate was 100% in both Group 3-Fr (33/33 patients) and Group 4-Fr (29/29 patients). The duration of the procedure with fluoroscopy did not differ significantly between Group 3-Fr (mean 28.0 min; range 4.5-77.4 min) and Group 4-Fr (mean 30.2 min; range 9.6-79.0 min) (P = 0.524), indicating that the maneuverability of the 3-French system is equivalent to that of the 4-French system (Fig. 2). No procedure-related complications were observed in either Group.

![Image](122.png)

Fig. 1. A 61-year-old man with hypopharyngeal cancer. Contrast-enhanced computed tomography reveals a tumor on his right pyriform fossa (arrow) (a). The vascular anatomy of the head and neck is clearly clarified by cerebral angiography after right common carotid injection (lateral view) via a 3.5-French angiographic catheter (b). Superselective angiography of the superior thyroid artery (frontal view) using a 2.4-French microcatheter shows small tumor-feeding vessels (arrow) and tumor staining (arrowhead) (c).

![Image](123.png)

Fig. 2. The duration of the procedure with fluoroscopy is not significantly different between Group 3-Fr and Group 4-Fr (P = 0.524).
3-Fr (0/33 patients) or Group 4-Fr (0/29 patients). In Group 3-Fr, after removing the bandage and ambulation, no hemorrhagic complication was observed (0/33 patients) despite the shortened bed rest time (1.5 h).

**DISCUSSION**

Hemorrhagic complications and/or prolonged compression of the puncture site to prevent these complications can cause patients undue burden. Further, prolonged compression of the puncture site may increase the risk of pulmonary embolism from femoral venous thrombosis. Decreasing the size of the catheter system may shorten the bed rest time with compression of the puncture site, reduce the rate of hemorrhagic complications, and permit early ambulation. A few reports evaluate the utility of interventional procedures using 4-French catheter systems, and these reports described the diagnostic accuracy, high technical success rate, and early ambulation achieved with these procedures. Kiyosue et al. used a 4-French catheter system for selective transcatheter angiography and intervention in the abdomen and reported that the rates of hemorrhagic complications in the 4-French group (hematoma, 2.3%; oozing, 14%; and rhexis, 0%) were significantly lower than those in the 5-French (3%, 21%, and 0%, respectively) and 7-French (11%, 19%, and 2.4%, respectively) groups. However, downsizing the catheter has several disadvantages. The maneuverability and the angiographic image quality with small catheters may be unsatisfactory, and these factors may lead to prolonged procedure time and a lower technical success rate. Regarding interventions for head and neck lesions in particular, maneuverability is an important factor because the distance from the puncture site to the target area is long and the catheter needs to pass a sharp angle to reach the cervical artery from the aortic arch. Furthermore, prolongation of the procedure time can potentially increase the risk of neurologic complications. In this study, the technical success rate was 100% in both Group 3-Fr and Group 4-Fr. In addition, the duration of the procedure with fluoroscopy was not longer in Group 3-Fr than in Group 4-Fr. These results suggest that the 3-French system retains the performance of the catheter and the flexibility of the guidewire and that it is as safe as the 4-French system for interventional procedures for head and neck cancer. Neurogenic complications associated with interventions for head and neck cancer are rare, but they can be serious. According to previous reports, neurogenic complications occur in 0.5-3% of patients and prolongation of the procedure can increase the risk of cerebral infarction (18-20). In this study, no complication was observed in either group and the duration of the procedure with fluoroscopy was not significantly different between the groups.

According to previous reports, 4 h is the standard bed rest time after interventional procedures performed via a transfemoral approach. A few reports evaluated the feasibility of shortening the bed rest time using a 4-French catheter system, and consequently, patient symptoms such as back pain or leg stiffness were reduced. Shortening the bed rest time may help to reduce the risk of pulmonary embolism. Kato et al. evaluated the feasibility of shortening the bed rest time from 4 to 2 h using a 4-5-French catheter system in transfemoral noncardiac angiography. They observed no minor or major bleeding at the puncture site after 2 h of bed rest. In head and neck lesions, Wagenbach et al. investigated the feasibility of early ambulation after diagnostic and therapeutic neurovascular procedures using 4-French or larger catheters through the femoral artery. They reported that 66.4% of patients after diagnostic procedures and 25.9% of patients after therapeutic procedures ambulated within 3 h. Hemorrhagic complications at the puncture site after the catheterization were observed in 4.7% of
patients. One patient had a large hematoma that required surgical evacuation. No hemorrhagic complication was observed after 1.5 h of bed rest in this study. Using devices based on 3-French systems, 1.5 h of bed rest is feasible and safe for patients undergoing intra-arterial chemotherapy, and furthermore, intra-arterial chemoembolization for head and neck cancer in outpatients may be feasible as a consequence.

Transbrachial and transradial approaches have been used for selective neuroangiography. The advantage of these techniques is a reduction in patient restrictions with immediate ambulation after the procedure. However, some reports of transbrachial and transradial approaches described a relatively higher occurrence of significant local complications, such as arterial thrombosis and dissection. In addition, intra-arterial chemotherapy was performed several times in short durations in many cases. The risk of arterial thrombosis and dissection may increase with an increase in the duration of the procedure.

This study had several limitations. First, this study included a relatively small number of patients. In addition, in patients with severe arteriosclerosis who require sensitive maneuver, there is a possibility that 4-French systems have some advantages. However, in this study, the longest duration of the procedure with fluoroscopy in Group 3-Fr (77.4 min) was not longer than that in Group 4-Fr (79.0 min). Finally, the same operator did not perform all procedures. Operator skill may affect the results of this study. However, all operators in this study were experts, with 12-17 years of experience in interventional radiology.

In conclusion, transfemoral intra-arterial chemotherapy for head and neck cancer using a 3-French catheter system is as safe as using a 4-French catheter system and is technically feasible, with approximately the same duration of the procedure with fluoroscopy. The 3-French catheter system permits shortening of the bed rest time without causing hemorrhagic complications and can reduce the risk of pulmonary embolism.

REFERENCES
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