Evaluation of the Origin of Feeding Arteries in Recurrent Tongue Cancers Treated with Intra-Arterial Infusion Chemotherapy

Abstract

Purpose: To evaluate the origin of feeding arteries in recurrent tongue cancers under treatment with intra-arterial infusion chemotherapy (IAIC).

Material and Methods: Eleven patients who underwent IAIC for recurrent tongue cancer at our institute between January 2007 and August 2017 were enrolled. Two patients received a second IAIC treatment for tumor recurrence after the first round of IAIC. Thus, 13 recurrent tongue tumors were evaluated. The main and accompanying feeding arteries were identified on super-selective angiography of the branches of the external carotid artery.

Results: The main feeding artery was the ipsilateral lingual artery (LA) in 7 of the 13 (54%) tumors, the contralateral LA in 3 (24%) tumors, and the ipsilateral superior thyroid artery (STA) in 3 (24%) tumors. Feeding was detected from the ipsilateral LA in 12 of the 13 tumors (92%), from the contralateral LA in 8 (62%), from the ipsilateral facial artery (FA) in 3 (23%), from the contralateral FA in 1 (8%), from the ipsilateral STA in 3 (23%), from the contralateral STA in 2 (15%), and from the artery anastomosed to a flap in 2 (15%). Three tumors (23%) had only 1 feeding artery, and multiple feeders were detected in the remaining 10 (77%). Of the 10 tumors with multiple feeding arteries, 4 tumors had 2 feeding arteries, 4 tumors had 3 feeding arteries, and the other 2 tumors had 4 feeding arteries.

Conclusions: Recurrent tongue cancers are often supplied by multiple feeding arteries. A careful search for feeding arteries including the STA is required.

Key words: tongue cancer, intra-arterial infusion chemotherapy, feeding artery

Introduction

Intra-arterial infusion chemotherapy (IAIC) has the advantage of delivering a high concentration of drugs into a tumor [1]. While there have been a number of reports on super-selective IAIC via the femoral artery using the Seldinger technique [2-6], the effectiveness of IAIC in the treatment of...
locally advanced head and neck cancer remains controversial [7]. IAIC for tongue cancer can provide good local control and functional preservation. The procedure can also be an elective treatment for recurrent tongue cancer, because in such cases, the majority of patients have already undergone radiotherapy for the primary lesion and further radiotherapy cannot be performed. Accurate detection of feeding arteries is important in the administration of IAIC. Although most tongue cancers receive their blood supply from the lingual artery (LA), it is well known that some tongue cancers have multiple feeding arteries. A previous study of primary tongue cancer found that these cancers are often supplied by multiple feeding arteries and that a careful search for feeding arteries is required in large tumors with extension to the contralateral side or to the extrinsic tongue muscles [8]. Feeding arteries of recurrent tongue cancers may have different characteristics from those of primary tongue cancers. Surgical arterial ligation, postoperative inflammation, and radiotherapy might affect hemodynamics in recurrent cancer. To the best of our knowledge, no previous studies have evaluated the feeding arteries in recurrent tongue cancer. Thus, the purpose of the present study was to evaluate the origin of the feeding arteries in recurrent tongue cancer treated using IAIC.

### Materials and Methods

#### Patients

This retrospective study was approved by the Ethical Review Board on Clinical Study at our institution. The requirement for informed consent was waived. Eleven patients (mean age, 54.8 years; overall age range 43-69 years; 4 men and 7 women) who underwent IAIC for recurrent tongue cancer at our institute between January 2007 and August 2017 were enrolled in this study. Two patients received another round of IAIC for a second recurrence after the first round of IAIC performed for recurrent tongue cancer. Thus, a total of 13 recurrent tongue tumors were evaluated. Patient characteristics are shown in Table 1.

#### IAIC protocols and evaluation of imaging findings

IAIC was indicated in patients with local recurrence and without distant metastasis, and was performed for local control or as induction chemotherapy prior to salvage surgery. Angiography was performed using an AXIOM Artis dBA (Siemens, Erlangen, Germany). Arterial catheterization was performed via the femoral artery using the Seldinger technique. Routine diagnostic angiography was performed with a 5-French diagnostic catheter using the digital subtraction technique. First, the common carotid artery was examined to assess the bifurcation of the carotid artery and the origin of the feeding vessel. After the catheter was inserted into the external carotid artery (ECA), the coaxial technique was used to place a 2.8-French microcatheter (Renegade HI-FLO Microcatheter; Boston Scientific, Natick, MA, USA) or a 2.4-French microcatheter (MicroFerret Infusion Catheter; Cook Medical, Bloomington, IN, USA) in the branches of the ECA. Feeding arteries of recurrent tongue cancers may have different characteristics from those of primary tongue cancers. Surgical arterial ligation, postoperative inflammation, and radiotherapy might affect hemodynamics in recurrent cancer. To the best of our knowledge, no previous studies have evaluated the feeding arteries in recurrent tongue cancer. Thus, the purpose of the present study was to evaluate the origin of the feeding arteries in recurrent tongue cancer treated using IAIC.

### Table 1. Patient’s profiles and feeding arteries

| Case | Gender | Side | Size (mm) | r-Stage | Previous treatment | Time from treatment | ps LA | conra LA | ps FA | conra FA | ps STA | conra STA | Flap artery | Local response | Number of times | Treatment followed | Survival period | Dead/Alive |
|------|--------|------|-----------|---------|-------------------|---------------------|-------|----------|-------|----------|-------|-----------|-------------|----------------|----------------|----------------|------------|
| 1    | M      | base | 36        | rT4N0M0 | CRT + IAIC + surgery | 5 mos.              | -     | -        | -     | -        | -     | -         | -           | PD             | 1              | surgery + CRT   | 9 yrs.       | alive       |
| 2    | M      | body | 40        | rT4N0M0 | BT                | 2 mos.              | -     | -        | -     | -        | -     | -         | -           | PR             | 1              | surgery        | 10 mos.      | dead        |
| 3(2) | M      | body | 33        | rT4N0M0 | BT + IAIC + surgery | 4 mos.              | -     | -        | -     | -        | -     | -         | -           | N/A            | 1              | surgery        | 5 mos.       | dead        |
| 4    | M      | body | 32        | rT4N0M0 | Surgery + CRT     | 6 mos.              | O     | -        | O     | -        | -     | -         | -           | SD             | 1              | surgery        | 5 mos.       | unknown     |
| 5    | F      | body | 32        | rT4N0M0 | Surgery + CRT     | 6 mos.              | -     | -        | O     | -        | -     | -         | -           | PR             | 5              | none           | 7 yrs.       | alive       |
| 6    | M      | body | 36        | rT4N0M0 | Surgery           | 2 mos.              | -     | -        | O     | -        | -     | -         | -           | N/A            | 1              | surgery + CT    | 7 mos.       | dead        |
| 7    | F      | body | 34        | rT4N0M0 | IAIC + CRT        | 4 mos.              | O     | -        | O     | -        | -     | -         | -           | SD             | 1              | surgery + CT    | 14 mos.      | dead        |
| 8    | F      | body | 18        | rT4N0M0 | BT                | 18 yrs.             | -     | -        | -     | -        | -     | -         | -           | N/A            | 1              | surgery + CT    | 6 yrs.       | alive       |
| 9(5) | F      | body | 23        | rT4N0M0 | Surgery + CRT + IAIC | 10 mos.             | O     | -        | O     | -        | -     | -         | -           | CR             | 3              | surgery        | 6 yrs.       | alive       |
| 10   | F      | body | 42        | rT4N0M0 | Surgery + CRT     | 7 yrs.              | -     | -        | O     | -        | -     | -         | -           | SD             | 1              | surgery + CT    | 10 mos.      | dead        |
| 11   | F      | body | 32        | rT4N0M0 | BT                | 24 yrs.             | -     | -        | O     | -        | -     | -         | -           | PR             | 1              | surgery        | 4 yrs.       | alive       |
| 12   | M      | body | 37        | rT4N0M0 | CT + surgery      | 15 mos.             | O     | -        | O     | -        | -     | -         | -           | N/A            | 2              | surgery + CRT   | 20 mos.      | dead        |
| 13   | M      | base | 30        | rT2N0M0 | CRT               | 6 mos.              | O     | -        | O     | -        | -     | -         | -           | N/A            | 2              | CRT           | 17 mos.      | dead        |

CRT = chemoradiotherapy, IAIC = intra-arterial infusion chemotherapy, BT = brachytherapy, CT = chemotherapy

© main feeder, ○ accompanying feeder, – completely ligated by surgery, N/A = not applicable

CR = complete response, PR = partial response, SD = stable disease, PD = progressive disease
supplying vessels, the drug doses were divided according to the stained tumor volume. The presence or absence of blood supply was determined by the operator and the assistant during each IAIC. In addition, two radiologists (T.K., with 19 years of experience, and Y.Y., with 12 years of experience) reviewed and reaffirmed the identification of the feeding arteries by consensus in this study. For patients who were judged to require multiple courses of chemotherapy, IAIC was repeated in intervals of 4-6 weeks. Following IAIC, patients underwent salvage surgery, with the exception of 1 patient who refused surgery, 1 patient in whom lung metastasis was detected after IAIC, and 1 patient who was judged to be inoperable based on his general condition. No patient underwent concurrent radiotherapy.

Results

Details for all patients are shown in Table 1. The local response rate was 54% (complete response, 1 case; partial response, 6 cases). The 2-year survival rate was 42% and the 5-year survival rate was 36%. Feeding from the ipsilateral LA was detected in 12 of the 13 tumors (92%), but not observed in a case in which the ipsilateral LA was completely ligated. Feeding was also detected from the contralateral LA in 8 (62%), from the ipsilateral facial artery (FA) in 3 (23%), from the contralateral FA in 1 (8%), from the ipsilateral superior thyroid artery (STA) in 2 (15%), from the contralateral STA in 2 (15%), and from the artery anastomosed to a flap in 2 tumors (15%). Of these 2 arteries anastomosed to a flap, 1 was anastomosed to the STA and the other was anastomosed to the superficial cervical artery. Three cancers (23%) had only 1 feeding artery, and multiple feeding arteries were detected in the remaining 9 (77%). Of the 9 tumors with multiple feeding arteries, 4 tumors had 2 feeding arteries, 3 tumors had 3 feeding arteries, and other 2 tumors had 4 feeding arteries. The main feeding artery was the ipsilateral LA in 7 of the 13 (54%) tumors, the contralateral LA in 3 (24%) tumors, and the ipsilateral STA in 3 (24%) tumors. There was no tumor for which the main feeding artery was the FA or the contralateral STA. Four of the 5 tumors with a main feeder other than the ipsilateral LA were postoperative cases. The ipsilateral LA was completely ligated in 1 patient and partially ligated in 3 patients. Two of the 3 recurrent tumors that received supply mainly from the STA were postoperative cases. These tumors were located in the tongue base and invaded the epiglottic vallecula. A representative case is shown in Fig. 1.

Discussion

The majority of patients with recurrent tongue cancer have already undergone radiotherapy for the primary lesion, and thus further radiotherapy cannot be performed. Surgical salvage is therefore often indicated for locoregional recurrent tongue cancer [9, 10]. While the efficacy of preoperative or palliative IAIC for locally advanced tongue cancer has been reported, the effectiveness of this procedure in the treatment of recurrent head and neck cancer remains unclear [11-13]. In our institute, we also have performed IAIC for recurrent tongue cancer as induction chemotherapy prior to salvage surgery or as palliative therapy.

Detection of the feeding arteries is important in IAIC. Because some tumors are supplied by multiple feeding arteries or receive blood from an unexpected feeding artery as a variant, it is essential to carefully search for and identify the feeding arteries on angiography so that the maximum therapeutic effect can be achieved [8]. A previous study of primary tongue cancer reported that half of primary tongue cancers had multiple feeding arteries [8]. In the current study, 77% of the recurrent tongue cancers were supplied by multiple feeding arteries. Recurrent tongue cancers tend to have more feeding arteries than primary tongue cancers. Surgical arterial ligation, postoperative inflammation, and radiotherapy might affect the hemodynamics in recurrent cancers. Feeding from the contralateral LA was detected in 8 of 13 cases in the present study. This incidence was high compared with a previous examination of primary tongue cancers [8]. Contralateral LA angiography and confirmation of the presence or absence of feeding from the contralateral LA is thus essential for recurrent tongue cancers. Feeding from the FA was detected in 3 of the 13 cases in the current study. This rate was equivalent to that observed in primary tongue cancers. On the other hand, supply from the STA was detected in 3 cases, although previous research demonstrated that feeding from the STA was not detected in any primary tongue cancer. Two of the 3 recurrent tumors supplied from the STA were postoperative cases. They were located in the tongue base and invaded to the epiglottic vallecula. There is a possibility that tumors with epiglottic vallecula extensions are fed by the STA because the epiglottic vallecula is supplied not only by the lingual and superior thyroid branches of the LA but also by the infrahyoid branches of the STA [14]. The previously cited study of primary tongue cancer stated that no tongue tumors, even tumors with epiglottic vallecula extensions, were fed by the STA and that there may be no substantial need for STA angiography [8]. However, in recurrent tongue cancer, especially in cases of preoperative recurrence, it is necessary to confirm the presence or absence of feeding from the STA when an epiglottic vallecula extension is detected. Supply from the artery anastomosed to a flap was also detected in 2 cases. It is also important to pay attention to the artery anastomosed to a flap in postoperative recurrent cancers.

The present study has some limitations. First, the number of cases was small. Previous research showed that tumor size, extension to the contralateral side, and extension to the external tongue muscle correlated with the number of feeding arteries of primary tongue cancers [8]. We should have evaluated the relationship between these factors and feeding arteries in a similar way; however, we were unable to perform this analysis because of the small number of cases in...
Figure 1. A 56-year-old female patient with recurrent tongue cancer (Case 9) T2-weighted MR images show a mass in the right tongue base with extension to the epiglottic vallecula (A, B). Cone beam CT under an infusion of contrast media via the right lingual artery (C), the left lingual artery (D), the right superior thyroid artery (E), and the left superior thyroid artery (F) show enhancement in the tumor.

In conclusion, recurrent tongue cancers are often supplied by multiple feeding arteries. A careful search for feeding arteries including the STA is required.


Conflict of Interests: The authors have no conflict of interest to disclose concerning this article.

References


