Case Report
Early computed tomography for detection of internal jugular vein thrombosis after neck dissection and/or reconstruction surgery for head and neck cancer patients

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Abstract: Internal jugular vein thrombosis (IJVT) is a complication that occurs after radical neck dissection (ND) and/or reconstruction surgery for patients with head and neck (H&N) cancer. As a protocol, follow-up computed tomography (CT) is performed after cancer resection to detect residual cancer, recurrence, or metastasis. In contrast, there are no clear guidelines for the detection of IJVT after H&N cancer therapy. We report the case of a 67-year-old woman with IJVT subsequent to H&N surgery for tongue cancer. To our knowledge, this is the first case of IJVT after combined supraomohyoid ND and anterolateral thigh flap reconstruction using the internal jugular vein. Further evaluation of swelling and reddening of the right mandibular and neck area by CT scan was performed 71 h postoperatively, and IJVT was clearly detected. Routine CT for patients with H&N cancer is performed at least 4-8 weeks postoperatively, which is too late for safe detection of IJVT and worsens the prognosis of the patient because of pulmonary embolism or flap failure. Based on literature review, we suggest that CT should be performed within a week after ND and/or reconstruction surgery for H&N cancer to detect IJVT at the earliest time point.

Keywords: Head and neck cancer, tongue cancer, internal jugular vein, thrombosis, neck dissection, reconstruction surgery, computed tomography, case report

Introduction

Worldwide, approximately 980,000 cases of head and neck (H&N) cancer (including thyroid) occurred per year, and approximately 40% of patients with this cancer died per year [1]. The standard method for radical treatment of this cancer is neck dissection (ND) [2], with reconstructive surgery performed to treat the defect after primary cancer resection and ND [3]. However, ND and reconstructive surgery have risks for various complications [4-6].

Internal jugular vein (IJV) thrombosis (IJVT) is one complication after radical ND and/or reconstruction surgery for patients with H&N cancer [7]. IJVT has two serious risks after reconstruction surgery for H&N cancer patients, including life-threatening pulmonary embolism (PE) [8, 9] and flap failure [10, 11]. However, there is no accurate protocol for detecting IJVT after H&N cancer treatment, because IJVT rate is vague, especially after selective neck dissection (SND) such as a supraomohyoid ND (SOHND) [12-15]. Conversely, after cancer resection, follow-up computed tomography (CT) is performed as a protocol at least 4-8 weeks after therapy to detect residual cancer, recurrence or metastasis [2]. However, this protocol is not performed to detect IJVT [2].
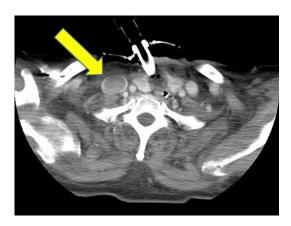
Figure 1. Contrast-enhanced computed tomography scan performed 71 h postoperatively revealed a poorly contrasted area in the right internal jugular vein (IJV), and IJV thrombus was radiologically diagnosed.

We report a case of IJVT of tongue cancer after SOHND and anterolateral thigh (ALT) flap reconstruction. Contrast-enhanced CT was performed owing to her clinical symptoms. IJVT was detected by CT within 3 days after the surgery.

Case report

A 67-year-old female was referred to the Department of Oral and Maxillofacial Surgery, University Hospital of the Ryukyus (Okinawa, Japan), for treatment of right tongue lesion in August 2016. She had a 2.5 month history of tongue pain. Physical examination revealed a hard 2.3 × 1.8 cm mass with an ulcer on the right tongue extending to the oral floor. No palpable lymphadenopathy was found in the neck area. She underwent a resection for uterine cancer (endometrioid adenocarcinoma), i.e., total abdominal hysterectomy with bilateral salpingo-oophorectomy at our institute in 2005. No radiation or chemotherapy was performed for the uterine cancer. She had no history of smoking and drinking. No other family history was found. The tongue mass was clinically suspicious for cancer. For cancer staging, contrast-enhanced CT (head to chest regions), magnetic resonance imaging (head and neck regions), upper gastrointestinal endoscopy, and 2-[18F]-fluoro-2-deoxy-D-glucose (FDG)-positron emission tomography (PET) were performed. Contrast-enhanced CT revealed tongue lesion; however, there were no visible radiological changes in the neck lymph nodes, and the internal jugular vein (IJV) was normal. Further whole-body PET revealed increased FDG uptake in the right tongue; no neck lymph nodes had strong FDG uptake. No other malignant lesion was found, and no abnormality was found in the IJV. Additionally, no abnormal coagulation test results were found before the cancer treatment. Histopathological diagnosis of the tongue mass biopsy was well-to-moderately differentiated squamous cell carcinoma. Final diagnosis was tongue to oral floor squamous cell carcinoma (T4aN0M0, Stage IVa; UICC TNM classification 7th edition, 2009). Neoadjuvant chemotherapy (TS-1 tegafur-gimeracil-oteracil potassium 100 mg/day for 2 weeks) was administered for the tongue cancer.

We performed tumor resection, right SOHND (IJV was preserved), and ALT flap reconstruction to reconstruct large tongue and neck defects. On the artery side, we first planned a combination of right lateral femoral circumflex artery (LFCA) anastomosed end-to-end to the right lingual artery. However, the patient showed reduction in the blood flow to the flap, and arterial thrombosis was observed. Therefore, the artery anastomosis was resected, and a new anastomosis (a combination of the right LFCA anastomosed end-to-end to the right superior thyroid artery) was performed. The artery intima on the flap side was partially calcified. Thrombosis immediately recurred after the anastomosis. Therefore, the anastomosis was resected; the thrombosis was removed, and the arteries were anastomosed again. After the additional treatment, a stable blood flow was observed. On the vein side, the right lateral femoral circumflex vein was anastomosed side-to-end to the IJV. Histopathological examination revealed well-differentiated squamous cell carcinoma of the tongue with no metastatic lymph node at levels I-III. Central venous catheter was inserted in the groin area, and it remained inside even after the surgery.

We observed the patient in our intensive care unit for 48 h postoperatively. To check the ALT flap, pinprick and Doppler tests were performed. At 68 h postoperatively, we noticed that the right mandibular and neck areas were swollen and red. When the lesion was found, the Doppler sound was clearly identified, and no abnormal lesion was found by the pin prick test. To evaluate the lesion, we performed contrast-enhanced CT and revealed a poorly con-

trasted area in the right IJV, and IJVT was diagnosed radiologically (**Figure 1**). Conversely, no hemorrhage (extravasation), cancerous lesion, or abscess was revealed. A vascular surgeon, pulmonologist, and cardiologist were consulted, and IJVT was clinically diagnosed, with no thrombi noted in the patient's body by the whole-body contrast-enhanced CT scan. Follow-up protocol CT scan performed 1, 2, 6, and 12 months after the surgery showed that IJVT has been resolved. Until 1.5 years after the resection, she was conservatively treated using medicines. Intravenous heparin for one month followed by warfarin for six months and subsequent aspirin for one year was administered to the patient. After follow-up of 1 year and 11 months, the patient was doing well with no evidence of cancer recurrence or metastatic disease, and the translated flap remained healthy to date. There was no abnormal event related to IJVT. The clot gradually became smaller, and no other event has occurred to date.

Written informed consent was obtained from the patient for publication of this case report and all accompanying images. The Ethics Committee of the University of the Ryukyus waived the requirement for review per institutional protocol, as the study did not contain content that requires ethical approval, and approved the submission and publication of this case report.

Discussion

We found two important issues in this case: (I) To our knowledge, this is the first case report of IJVT after combined SOHND and ALT flap reconstruction using the IJV, and (II) CT scan clearly detected IJVT within 1 week postoperatively.

We performed a literature search using PubMed and Google Scholar articles published from 1906 [16] to 2018 using the following terminological combinations: "internal jugular vein; internal jugular venous; jugular vein", AND "thrombosis; stenosis; occlusion; patency", AND, "neck dissection; supraomohyoid neck dissection; upper neck dissection; selective neck dissection; elective neck dissection". We excluded non-English literature or English conference proceedings. We found two cases of IJVT associated with SOHND [17, 18]. However, the current combination (IJVT after SOHND and ALT using the IJV) was not found. For patients with H&N cancer, ND is a standard method for radi-

cal treatment [2]. Of the several types of NDs, SND is a conservative method and has been replacing radical ND [19]. SOHND is a type of SND that is selected in cases of limited local invasive H&N cancer to preserve function and minimize the esthetic deformity [20]. Reconstruction of the defect is also important to restore function and esthetics, as well as to control the cancer [6]. Therefore, flap failure of reconstruction surgery should be avoided [21]. In H&N reconstruction, many types of flaps have been reported [22]. Of those, the combination of ALT and IJV is used frequently in ND for three reasons: (I) ALT has a high flap survival rate (97.8%) compared with other flaps used for H&N reconstruction [23]. (II) The IJV can be used freely for end-to-end or end-to-side anastomosis even when there are no branches [7]. Many reports described use of the IJV [3, 24-26]. (III) The IJV is used mostly during ND (including SOHND) and reconstruction because it has a small risk of venous twist and a large diameter with reliable venous blood flow [7, 20, 27]. Use of the ALT was first described by Song and colleagues [28], and the flap has been used worldwide because of its reliability and less donor site morbidity [5, 23]. The ALT flap is versatile and ideal for H&N reconstruction; however, flap compromise and failure cannot be avoided even in the hands of experienced surgeons [5, 29]. Moreover, Wong and colleagues [30] performed a multivariate analysis and reported that flap failure occurs significantly more often at the H&N site than at other sites in the body. One reason for flap failure is vascular thrombosis [6].

IJVT is a rare lesion occurring after H&N surgery that has serious consequences [31]. For example, IJVT has the possibility for causing other site thromboses [8]. IJVT has two serious risks after reconstruction surgery, including flap failure as described above [6], and life-threatening PE [8, 9, 12, 32-34]. ND and/or reconstruction surgery have a risk for IJVT [21, 31]. In our patient, IJVT might have occurred because of the IJV narrowing after SOHND, as indicated by Harada and colleagues [12]. Increased operation time, blood loss, endothelial venous injury, central venous catheterization or dryness of the vein, salivary fistula or postoperative infection, and radiotherapy also increase the risk of IJVT [9, 13, 14, 35]. Further, cancer itself is a risk of the thrombosis (localized cancer-associ-

ated thrombosis by increasing coagulability) [26, 36, 37]. Therefore, treatment of H&N cancer using techniques such as ND and/or reconstruction surgery has many risks for IJVT. As described above, IJVT leads not only to flap failure but also to life-threatening PE. For example, in a study of 300 patients with upper-extremity deep venous thrombosis, approximately 2% resulted in PE [38]. In cases of IJVT, the patient should be continuously and closely monitored postoperatively owing to a significant risk of developing PE [17]. Actually, PE is one of the reasons of sudden death after ND [34].

Our second important finding was that CT clearly detected IJVT. After any type of ND and/or reconstruction surgery for H&N cancer patients, the clinician should detect IJVT for three reasons.

First, IJVT can occur regardless of the type of ND. Overall, the IJVT rate after ND (radical, modified, or functional neck dissection [FND]) is well described [21, 39, 40]. However, the IJVT rate after SND was less reported. To date, some reports described the rate of the IJV occlusion or IJVT; however, the occlusion and thrombosis are confused [15, 41, 42]. Basically, an occlusion is defined as the result of a thrombosis [29]. Therefore, to distinguish "occlusion" and "thrombosis", we accurately report them in **Table 1** with a literature review as defined above [3, 10, 12-15, 21, 35, 39-53]. IJVT can occur at various rates after ND [54]. **Table 1** indicates that 0%-30.4% of IJVT occurred after ND. In regards to SND, Hudgins and colleagues [14] reported a 20% rate of IJVT after SND; however, the sample size in the study was small (8 of 26 cases). Quraishi and colleagues [13] described the IJVT rate after FND or SND, but the rate was not distinguished between FND and SND. Cappiello and colleagues [43] reported lateral ND as SND [43]. However, those reports are small and limited to describing the association between SND and IJVT. Abovementioned reports did not define the IJVT rate after SND [13, 14, 43]. Notably, Harada and colleagues [12] reported that the caliber of the IJV reduces but gradually increases after 1 and 3 months of any other type of ND (including SOHND). Small caliber (vein narrowing) is a risk for IJVT [35, 44]. Therefore, the results of Harada and colleagues [12] can be postulated to indicate that IJVT can occur regardless of the type of ND. So, as described above, the clini-

cian should prevent or detect IJVT after any type of ND.

Second, IJVT possibly may be asymptomatic. In our patient, cervical swelling was the key symptom for detecting IJVT, and subsequent contrast-enhanced CT confirmed it. Cervical swelling (edema), pain, and flap congestion are the main clinical manifestations of IJVT [9, 45]. However, the symptoms are not specific for IJVT but are commonly observed after ND or reconstruction surgery [21, 46]. By contrast, edema is not always associated with IJVT [55], and clinical manifestations are not observed in all IJVT patients [8]. However, IJVT has serious risks as indicated above. Therefore, the clinicians should notice IJVT whether the clinical symptom manifests or not.

Thirdly, IJVT is difficult to prevent. In a systematic review and meta-analysis, Lee and Mun [11] found little evidence that use of antithrombotics reduces the risk of thrombosis or flap failure. Moreover, the authors also reported that the risk of using routine antithrombotics may exceed their benefits [11]. For example, after reconstruction surgery, hematoma, bleeding, and need for a blood transfusion are common complications [5, 34, 56]. The antithrombotics for prevention of thrombosis conversely cause other complications. Therefore, like in our case, antithrombotics are not routinely used [57]. Further, preoperative evaluation of the IJV could not predict IJVT [58], so there is a possibility that IJVT is inevitable [59].

Therefore, it is important to detect IJVT after occurrence. To detect IJVT, CT is a useful tool [8, 36, 60]. However, the standard protocol of postoperative CT is 4-8 weeks after therapy [2]. After cancer resection, follow-up CT is performed for residual cancer, recurrence, or metastasis as a protocol, i.e., at least 4-8 weeks after therapy [2]. By this time, it is late to detect IJVT because, as indicated in **Table 1**, IJVT can occur within 1 week after the ND and/or reconstruction surgery for H&N cancer treatment [3, 10, 13, 21, 45, 50, 53], and some case reports and case series also describe this fact [61, 62]. In our case, we used contrast-enhanced CT and detected IJVT 71 h after the surgery. Many investigators reported on evaluation of the IJV postoperatively using CT [17, 35, 36, 63, 64]. CT has great advantages to detect IJVT. (I): It can be used to confirm the PE [8]. Additionally,

Table 1. Reported studies of IJVT or IJV occlusion after ND

Author/References	Type of ND	Number of veins	Rate of IJV occlusion (%)	Rate of IJVT (%)	Time between the surgery to occurrence of IJVT
Fisher and colleagues (1988) [40]	FND	14	14.3	NA	(-)
Docherty and colleagues (1993) [44]	FND + radiotherapy (16 cases also underwent RS)	20	40	NA	(-)
	FND (2 cases also underwent RS)	8	0	NA	(-)
Lake and colleagues (1994) [47]	FND (some cases underwent RS)	35	2.9	NA	(-)
Cotter and colleagues (1994) [48]	Modified RND (4 cases also underwent RS)	79	14	NA	(-)
Leontsinis and colleagues (1995) [39]	FND (4 cases also underwent RS)	27	NA	29.6	NA
Zohar and colleagues (1995) [49]	FND or RND	31	12.9	3.2	14 months
Quraishi and colleagues (1997) [13]	FND or SND (some cases underwent RS)	81	NA	24.7	1 day
	FND or SND (some cases underwent RS)	72	NA	26.4	7 days
Wax and colleagues (1997) [50]	FND + RS	43	NA	18.6	1 and 7 days
Brown and colleagues (1998) [21]	Modified ND (16 cases also underwent RS)	29	NA	13.8	1-2 weeks
Güney and colleagues (1998) [51]	FND	133	NA	0	(-)
Katou and colleagues (1998) [45]	FND + RS or FND + RND + RS	38	0	2.6	7 days
Prim and colleagues (2000) [41]	FND	54	NA	0	(-)
Cappiello and colleagues (2002) [43]	Lateral ND (SND)	50	4	0	(-)
de Bree and colleagues (2002) [15]	Modified RND or SOHND or Anterolateral ND (all cases underwent RS)	23	NA	30.4	1 day-12.5 months
Kubo and colleagues (2002) [3]	FND + RS	58	6.9	3.4	2 and 8 days (2 cases)
Yucel and colleagues (2003) [52]	FND or modified radical ND type III	36	NA[a]	0	(-)
Harada and colleagues (2003) [12]	Modified RND or SOHND (39 necks also underwent RS)	76	NA[b]	0	(-)
Miyasaka and colleagues (2005) [10]	FND followed by RS	632	NA[c]	0.6	4-25 hours
Hudgins and colleagues (2005) [42]	SND	28	NA[d]	21.4[d]	4-50 months
Nagata and colleagues (2006) [14]	RND or modified RND or SOHND (21 necks also underwent RS)	29	3.4	NA	(-)
Fukuiwa and colleagues (2008) [53]	ND + RS (ND type was not mentioned.)	102	NA	2.9	2-7 days
Teymoortash and colleagues (2010) [46]	Many types of SND	98	NA	0	(-)
Makiguchi and colleagues (2015) [35]	Modified RND or Extended-SOHND (Level I-IV). 37 necks also underwent RS	81	7.4	0	(-)

Studies that described RS for head and neck defect but did not describe neck dissection were excluded. Case reports or case series were excluded. [a]Patency was described; however, occlusion was not apparent. [b]Some veins were reported as so narrow; however, they were not defined as an occlusion. [c]Two of 4 IJVT cases were described as occluded and obstructed; however, they were not apparent. [d]No detectable IJV by radiological findings were presumed as IJVT but not as occlusion. IJV, internal jugular vein; IJVT, internal jugular vein thrombosis; ND, neck dissection; FND, functional neck dissection; NA, not available; RND, radical neck dissection; SND, selective neck dissection; SOHND, supraomohyoid neck dissection; RS, reconstruction surgery.

CT can assess intrathoracic lesions (such as those in the lungs) more accurately than ultrasonography [60]. (II): CT can detect thromboses for a wide body range, because IJVT has the possibility for causing other site thromboses [8]. (III): CT can clearly evaluate the diameter of the vessel [36, 40]. In contrast, detection using ultrasonography depends on various parameters such as patient's obesity, edema, wounds, overlying bandages, as well as the clinician's technical experience [65]. As described above, CT is a convenient tool for detection of IJVT. However, there is no accurate protocol to detect IJVT after ND or reconstruction surgery for H&N cancer. By contrast, a defined protocol to detect the cancer exists [2]. IJVT can occur earlier because the immediate complication or reaction (such as wound infection, compression of the IJV by flap or hematoma, or fistula, which are the causes of IJVT) occurs immediately postoperatively [3, 54, 66]. Further, it takes a long time (4 days) from the first clinical symptom to diagnosis of IJVT [9]. Sometimes, the thrombosis does not affect the vein patency or flap failure [50, 61]; however, IJVT can cause sudden death after ND [50]. Therefore, IJVT should be detected at the earliest time point with CT.

This study has several limitations. First, current conclusions are based on only one case report, which limits the generalizability of findings. Second, this is a retrospective study as most studies on thrombosis following the flap operation of head and neck surgery are retrospective in nature [11]. Therefore, we believe that further prospective studies and accumulation of reported cases is warranted to establish a new protocol for detecting IJVT after cancer surgery.

In conclusion, we describe an extremely rare case of IJVT, and based on the observations, we suggest that CT should be performed within a week after ND and/or reconstruction surgery for H&N cancer to detect IJVT at the earliest time point. Because routine CT performed for patients with H&N cancer is very late for detecting IJVT safely, patient prognosis becomes worse due to pulmonary embolism or flap failure.

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Disclosure of conflict of interest

None.

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