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经口机器人与非机器人手术治疗舌根肿瘤的疗效对比

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摘　要　目的：比较经口机器人手术（TORS）与非机器人手术（NRS）治疗舌根肿瘤的疗效。方法：根据手术方式不同，将45例舌根肿瘤患者分为TORS组（n=19）和NRS组（n=26），对比分析两组患者的手术指标及术后并发症情况。结果：与NRS组相比，TORS组手术时间更短、出血量更少、术后住院天数更短，术后复发率更低。术后30 d内，NRS组患者吞咽困难、开口受限等并发症发生率高于TORS组，差异有统计学意义（P<0.05）。结论：TORS治疗舌根肿瘤具有术中出血少、损伤小、术后住院时间短、术后恢复快等微创优势。

关键词　舌根肿瘤；经口机器人手术；非机器人手术；微创外科；疗效；并发症

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Comparative study on the efficacy of transoral robotic surgery and non-robotic surgery for tongue base tumors

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Abstract　Objective: To compare the efficacy of transoral robotic surgery (TORS)and non-robotic surgery (NRS) in the treatment of tongue base tumors. Methods: A total of 45 patients with tongue base tumors treated in our hospital were selected, and they were divided into the TORS group and NRS group according to different surgical methods. The surgical indicators and postoperative complications of patients in the two groups were compared and analyzed. Results: Compared with the NRS group, the operative time, bleeding volume and length of hospital stay were less in the TORS group, and the postoperative recurrence rate was less in the TORS group than that in the NRS group. The incidence rate of dysphagia and restricted mouth opening in the TORS group was lower than that in the NRS group within 30 d after surgery, and the difference was statistically significant (P<0.05). Conclusion: TORS has better minimally invasive advantages in the treatment of tongue base tumors, including less intraoperative bleeding, smaller trauma, shorter length of hospital stay and faster recovery.

Key words　Tongue Base Tumor; Transoral Robotic Surgery; Non-robotic Surgery; Minimally Invasive Surgery; Efficacy; Complication

The base of tongue is located in the anterior wall of the oropharynx, and its anatomical location is concealed[1]. For malignant tumors of the tongue base, there are still different opinions on the surgical approach. The lateral pharyngeal approach is sometimes insufficient to fully expose the tumor perimeter, which may lead to tumor recurrence. In patients with malignant tumors of the tongue base, a longitudinal incision of the lower lip and splitting of the mandible can fully expose the tumor and facilitate complete resection, but it may lead to postoperative complications, poor aesthetic satisfaction, and the possibility of speech and swallowing dysfunction. Therefore, it is urgent to improve the treatment of

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patients with tongue base tumors by changing the treatment paradigm or technological advances. Efforts have been made to find a more conservative approach that can reduce the functional impact of surgical procedures while obtaining disease control rates close to those of radical surgery or radiotherapy.

With the development of medical technology and minimally invasive concept, the development and application of robot-assisted surgery was promoted[2]. TORS was approved by the U.S. Food and Drug Administration (FDA) in December 2009 for selective use in benign and malignant head and neck tumors[3]. TORS is a minimally invasive way to treat oropharyngeal tumors with the potential for complete tumor removal[4-6]. TORS has been shown to reduce the need for adjuvant therapy by avoiding chemotherapy, lowering the dose/range of adjuvant radiotherapy, or avoiding non-surgical treatment together. Some studies have shown that this downgrading of adjuvant therapy has the potential to improve swallowing outcomes and reduce reliance on nasal feeding tubes[7-8].

TORS has a magnified 3D high-definition vision and a flexible mechanical arm with 7 degrees of freedom. Its unique advantages are in line with the difficulties in the treatment of tongue base tumors. At present, studies have confirmed the safety and advantages of TORS in the treatment of oropharyngeal tumors. However, its superiority in the treatment of tongue base tumor and clinical effect comparing with non-robotic surgical treatment still need to be further confirmed.

1 Materials and methods

In this retrospective study, a total of 45 patients (19 cases of TORS and 26 cases of NRS) were enrolled. The inclusion criteria were the presence of tongue base tumor staged T_1 or T_2 according to TNM classification. Patients under poor general conditions and those with cervical lymph node metastasis showing radiological signs of invasion in the carotid artery or with tumors considered inadvisable for TORS by their CT or MRI results were excluded.

Clinical characteristics of patients in the two groups were shown in Table 1. There were no statistically significant differences in age, BMI and preoperative complications between the two groups (P>0.05), indicating that they were comparable.

In the TORS group, the Da Vinci Si surgical system was used, while direct resection of the tumor through oral cavity, resection through cervical approach, and resection through mandibular splitting approach were performed in the NRS group. The specific resection procedures were same in the two groups.

Observed indicators including operative time, blood loss, postoperative of hospital stay, time to oral diet, time to decannulation, drainage tube indentation, and nasal feeding tube dependence and postoperative complications within 30 days.

Statistical analysis was performed using SPSS V.21.0. The measurement data was represented as mean ± SD($\bar{x} \pm s$), and the classification variables were represented by the number of cases or percentage. T test was used for comparison of measurement data, and χ^2 test was used for counting data. P<0.05 was considered statistically significant.

2 Results

In benign tumors, the TORS group had longer operative time [(97.82 ± 44.31)min Vs (41.90 ± 25.06)min, P=0.0034] and higher cost [(8095.85 ± 1100.47) USD Vs (1935.85 ± 683.41) USD, P=0.0474] than the NRS group. The total operative time of the TORS group (excluding the time of TORS positioning) was shorter than that of the NRS group [(33.63 ± 30.40)min Vs (41.90 ± 25.06) min, P<0.0001]. No tracheotomy was performed in the two groups. Drainage tube was placed in 1 patient (10%) in the NRS group and nasogastric tube was placed in 1 patient (10%), but not in the TORS group. There was no significant difference in postoperative bleeding, decannulation time, oral feeding time and postoperative hospital stay between the two groups (see Table 2).

In malignant tumors, the TORS group was superior to the NRS group in terms of the total operative time [(35.63 ± 16.12) min Vs (81.56 ± 50.51) min, P<0.0001], blood loss [(30 ± 14.14) min (90.38 ± 76.54)min, P=0.0457] and postoperative hospital stay [(4.25 ± 2.44)d Vs (6.94 ± 3.98)d, P=0.0309]. The cost of the TORS group was higher

Table 1　Comparison of clinical data between the two groups of patients [*n* (%)]

Item	Overall (*n*=45)	TORS group (*n*=19)	NRS group (*n*=26)	*P* value
Age				0.5433
⩽ 60	28	13(0.68)	15(0.58)	
>60	17	6(0.32)	11(0.42)	
Gender				0.0052
Male	19	13(0.68)	6(0.23)	
Female	26	6(0.32)	20(0.77)	
BMI				0.1362
⩽ 23.9	23	7(0.37)	16(0.62)	
>23.9	22	12(0.63)	10(0.38)	
ASA classification				0.9447
Ⅰ	4	2(0.11)	2(0.08)	
Ⅱ	36	15(0.79)	21(0.81)	
Ⅲ	5	2(0.11)	3(0.12)	
Mallampati Score				0.8151
Ⅰ	4	2(0.11)	2(0.08)	
Ⅱ	37	16(0.84)	21(0.81)	
Ⅲ	1	0(0)	1(0.04)	
Ⅳ	3	1(0.05)	2(0.08)	
Preoperative comorbidities				0.9328
Hypertension	15	6(0.32)	9(0.35)	
Diabetes	4	2(0.11)	2(0.08)	
Liver disease	0	0(0)	0(0)	
Lung disease	3	1(0.05)	2(0.08)	
Kidney disease	1	0(0)	1(0.04)	
Angiocardiopathy	4	1(0.05)	3(0.12)	
Other diseases	2	1(0.05)	1(0.04)	
Prior radiation				0.9999
Yes	6	1(0.05)	5(0.19)	
No	39	18(0.95)	21(0.81)	
Perioperative coagulation				0.9999
Yes	5	2(0.11)	3(0.12)	
No	40	17(0.89)	23(0.88)	
Smoking and drinking				0.0858
Yes	12	8(0.42)	4(0.15)	
No	33	11(0.58)	22(0.85)	

Note: TORS (Transoral robotic surgery); NRS (Non-robotic Surgery)

than that of the NRS group [(9492.80 ± 1651.58)USD Vs (5190.39 ± 3009.02)USD, P<0.0001]. In the NRS group, 1 patient (6.25%) underwent tracheotomy, 1 patient (6.25%) was placed with drainage tube, and 4 patients (25%) were placed with nasogastric tube. There was no significant difference in total operative time, decannulation time and oral feeding time between the two groups (see Table 2).

During the long-term follow-up, the recurrence rates of the TORS group and the NRS groups were 12.5% and 50%, respectively(5.3% Vs 38.1%), P=0.0478.

In addition, the pathological types of malignant tongue base tumors in the TORS group and the NRS group were analyzed, and there was consistency between the two groups, so the pathological types did not cause differences in the recurrence rate of the two groups of surgical methods (see Table 3).

Dysphagia occurred in 2 patients of the TORS group and 8 patients of the NRS group within 30 days after surgery and, respectively (10.5% Vs 38.1%), P=0.0158. In the two groups, there were 1 patient in the TORS group and 7 patients in the NRS group had restriction of mouth opening within 30 days after surgery (5.3% Vs 33.3%), P=0.0461 (see Table 4). However, the number of complications within 30 days after surgery in the TORS group was less than that in the NRS group, except for accidental injury of teeth and gums.

Postoperative follow-up results showed that 3 patients with malignant tumors in the NRS group had obvious surgical scars, great changes in their faces comparing with that before surgery, and poor aesthetic satisfaction. All patients in the TORS group had scars hidden in the mouth, and no changes in their faces were observed before and after surgery.

Table 2　Comparison of surgical indicators between the two groups [$\bar{x} \pm s$, n (%)]

Item	Benign (n=21)		P value	Malignant (n=24)		P value
	TORS group (n=11)	NRS group (n=10)		TORS group (n=8)	NRS group (n=16)	
Total surgery time (min)	97.82 ± 44.31	41.90 ± 25.06	0.0034	107.12 ± 42.29	81.56 ± 50.51	0.2509
Operative time (min)	33.63 ± 30.40	41.90 ± 25.06	<0.0001	35.63 ± 16.12	81.56 ± 50.51	<0.0001
Tracheostomy tube	0	0	—	0	1(6.25)	—
Drainage tube	0	1(10.00)	—	0	1(6.25)	—
Blood loss(mL)	28.60 ± 25.10	18.00 ± 12.68	0.2644	30.00 ± 14.14	90.38 ± 76.54	0.0457
Time to decannulation (d)	0.72 ± 0.44	0.30 ± 0.60	0.1053	1.37 ± 0.99	1.81 ± 4.70	0.8083
Nasal feeding tube	0	1(10.00)	—	0	4(25.00)	—
Time to oral diet (d)	1.18 ± 0.38	1.80 ± 2.40	0.4329	1.62 ± 0.69	3.62 ± 5.50	0.3458
Postoperative hospitalization (d)	2.54 ± 0.98	4.00 ± 3.46	0.2197	4.25 ± 2.44	6.94 ± 3.98	0.0309
Mortality	0	0	—	0	0	—
Recurrence	0	0	—	1(12.5)	8(50.00)	0.0478
Cost (USD)	8095.85 ± 1100.47	1935.85 ± 683.41	0.0474	9492.80 ± 1651.58	5190.39 ± 3009.02	<0.0001

Table 3　Pathological types of malignant tumors of tongue base [n (%)]

Pathological type	NRS group (n=16)	TORS group (n=8)
Adenoid cystic carcinoma	7(43.75)	4(50.00)
Squamous cell carcinoma	7(43.75)	3(37.50)
Mucoepidermoid carcinoma	2(12.50)	1(12.50)

3 Discussion

The Da Vinci surgical system delivers superior visual effects and is able to remove tumors through the mouth while preserving critical structures and nerves[9–11]. Our study systematically compared the safety and efficacy of TORS with conventional approaches in patients with tongue base tumors.

Studies have shown that TORS can shorten the operative time compared with the open and transoral endoscopic surgeries. This study also verified the conclusion that the operative time of the TORS group was shorter than that of the NRS group in benign and malignant tumors of tongue base. In the study of Kayhan et al., the mean robotic set-up and exposure time was (13.0 ± 2.1) min (range 10–16 min) and the mean robotic surgery time was (8.8 ± 6.9) min (range 4–25 min)[12]. Our study took longer than Kayhan et al may due to two reasons. One is that the development of TORS is on its early stage, the operation is still not skilled, and the lack of experience in surgery; and the other reason is that the difficulty of surgical field exposure increased for the special location of tongue root tumor, thus prolonging the placement time. With the continuous accumulation of clinical cases, the docking time of robot will be gradually shortened.

Foreign surgeons routinely use TORS for tracheotomy to ensure breathing and reduce the risk of complications such as airway obstruction and bleeding. Yeh et al. found that the tracheotomy rate ranged from 0% to 3.5% as surgeons became more experienced[13]. Van et al. reported a TORS gas cut rate of 1%–7%[14–19]. In our study, 1 patient (6.25%) in the NRS group underwent tracheotomy. No tracheotomy was performed in the TORS group, which was consistent with that reported in the above studies. One big advantage of TORS tracheotomy is oropharyngeal approach, although it cannot be proved that routine use of tracheotomy is reasonable, but for older, poor body condition, operation involving multiple anatomical sites or preoperative evaluation, and is closely related to the great vessels, the prevention of trachea intubation is recommended.

In this study, nasogastric feeding tube (NGFT) was placed in 1 case (10%) of benign tumors in the NRS group. NGFT was placed in 4 cases of malignancies (25%) in the NRS group. The rate of NGFT placement in the NRS group was lower than that reported in the last study, which may be the selected patients were of early tumors. It should be noted that no nasogastric tube placed in the TORS group, which can be an obvious advantage.

At present, we followed up the TORS patients

Table 4 Comparison of complications within 30 days between the two groups [*n* (%)]

Complications	TORS group (*n*=19)	NRS group (*n*=26)	*P* value
Postoperative bleeding	2(10.50)	4(19.00)	0.6642
Hematoma	0	2(9.50)	0.4885
Wound infection	1(5.30)	3(14.30)	0.6071
Wound dehiscence	0	1(4.80)	>0.9999
Dysphagia	2(10.50)	8(38.10)	0.0158
Airway obstruction	0	1(4.80)	>0.9999
Hoarseness	3(15.80)	4(19.00)	>0.9999
Restriction of mouth opening	1(5.30)	7(33.30)	0.0461
Dysgeusia	1(5.30)	2(9.50)	>0.9999
Injuries to teeth, gums and lips	5(26.30)	4(19.00)	0.7116
Temporomandibular joint dislocation	1(5.30)	2(9.50)	>0.9999
Nerve palsy	0	3(14.30)	0.2327
Aspiration pneumonia	0	0	>0.9999
Pharyngeal fistula	0	1(4.80)	>0.9999

for 6–43 months, and the local control rate was 87.5%, which was consistent with previous studies. While the local control rate of the NRS group was 50%, indicated that TORS was superior to NRS in lowering the recurrence rate.

Results of the postoperative TORS in 19 patients with tongue base tumor showed that patients with a wider BMI and a larger neck circumference did increase their exposure time at the surgery site. But there was no significant difference in long-term treatment effect. Accordingly, the limitations on histological anatomy may be relaxed, but contraindications still need be strictly followed.

Bleeding is the most common complication in TORS[20]. Postoperative bleeding can range in severity from minor bleeding to severe active bleeding, which can even lead to life-threatening cardiopulmonary injury or death. Hay A et al. reported a major bleeding rate of 3.3% and a severe bleeding rate of 1.6%[21]. The mortality rate of TORS was very low, only 0.3%–0.7%, but the main cause of death was postoperative bleeding[22]. Bleeding usually occurred 6–14 days after surgery, with up to 83.6% of bleeding occurring at 2 weeks after surgery[23]. To reduce the potential complication, external carotid artery (ECA) ligation has been investigated as a procedure to reduce the incidence or severity of postoperative bleeding. Perioperative anticoagulant status, radiotherapy history, operator experience and tumor classification were all potential risk factors for postoperative bleeding[24–25].

There are many ways to stop bleeding in TORS, and the appropriate hemostasis method should be selected according to the specific situation. Postoperatively, the wound surface is exposed, and delayed bleeding may occur as blood pressure increases, the pseudomembrane abscission, and tongue movements such as coughing, speech, and swallowing.

Dysphagia is a common postoperative functional problem in patients with tongue base tumor, and is also one of the most concerned complications of tongue base tumor.

The limitation on the ability to safely ingest enough food and fluids puts patients at risk of complications such as malnutrition and aspiration pneumonia[26–27]. In addition, dysphagia and related complications increase the length of acute hospital stays and are associated with increased mortality, comorbidities, and health care costs[28]. 90% of patients in the TORS group took clean liquid food orally on the second day after surgery. 5–7 days after the operation, all aspects of body function recovered to the preoperative level, which is incomparable to non-robotic surgery.

It has been reported that conventional extubation was performed within 24–48 hours after TORS surgery, and the actual tracheotomy rate was lower than that reported in previous studies. In this study, no patients in the TORS group received tracheotomy, and there was no postoperative airway edema, ventilation disorders or inhalation symptoms, so we did not consider tracheotomy to be necessary.

Studies reported that in 77% of TORS patients NGFT was maintained for an average of 7.5 days to avoid bleeding due to swallowing movement. Studies have shown that NGFT does not prevent bleeding as expected. The main purpose is to avoid aspiration after surgery, but it can be used as an appropriate form of nutrition to ensure enteral nutrition.

The incidence of TORS nerve injury was low, and no neurological symptoms occurred in the TORS group in this study. Interestingly, the incidence of accidental tooth and mucosal injury in the TORS group was higher than that in the NRS group, which may be because the TORS performed by us was in the early stage of exploration, with less experience, and robotic arms lacking of tactile feedback, leading to a higher incidence of accidental injury. However, with the development of TORS and the accumulation of clinical experience, this problem can be gradually avoided.

At present, the cost of TORS may be high, with the average hospitalization cost reaching 10000 dollars, which is related to the acquisition cost, operation cost and maintenance cost. High cost is an important factor restricting the further development of surgical robot. However, our study found that the use of TORS in malignant tumors can reduce the length of hospital stay, thereby saving labor costs, faster postoperative recovery and return to life can also balance the cost of robotic surgery. The advantages

and functional outcomes of minimally invasive efficacy could justify these costs. Meanwhile, studies have shown that TORS can reduce the likelihood of adjuvant therapy.

4 Conclusion

TORS can provide better clinical outcomes in the treatment of tongue base tumors with a low recurrence rate. It has better minimally invasive advantages such as less intraoperative bleeding, smaller trauma, shorter postoperative hospitalization, faster recovery, and lower postoperative complication rate, but facing the limitation of higher cost.

Conflicts of Interest: There are no conflicts of interest in this study. All authors have read and approved this version of the paper, and due care has been taken to ensure the integrity of the work. Neither the entire paper nor any part of its content has been published or has been accepted elsewhere. It is not being submitted to any other journal.

Authorship Contribution: YU Wenjun was responsible for the drafting, study design and data analysis; LIN Quanquan was responsible for data collecting; FENG Lin was responsible for experiment design and data analysis; XI Qing was responsible for the surgical operation, and providing guidance and review to the drafting; ZHANG Haizhong was responsible for the surgical operation. All authors contributed to the writing and revision of the drafting.

Reference

[1] Philippe G. A contemporary review of evidence for transoral robotic surgery in laryngeal cancer[J]. Frontiers in Oncology, 2018. DOI: 10.3389/fonc.2018.00121.
[2] Mcleod I K, Mair E A, Melder P C. Potential applications of the da vinci minimally invasive surgical robotic system in otolaryngology[J]. Ear Nose Throat J, 2005, 84(8): 483–487.
[3] Rinaldi V, Pagani D, Torretta S, et al. Transoral robotic surgery in the management of head and neck tumours[J].Ecancermedicalscience, 2013, 7(1): 359.
[4] Dowthwaite S A, Franklin J H, Palma D A, et al. The role of transoral robotic surgery in the management of oropharyngeal cancer: a review of the literature[J].ISRN Oncology, 2012, 2012(24): 945162.
[5] Moore E J, Olsen K D, Kasperbauer J L. Transoral robotic surgery for oropharyngeal squamous cell carcinoma: a prospective study of feasibility and functional outcomes. [J].Laryngoscope, 2010, 119(11): 2156–2164.
[6] Almeida J R D, Genden E M. Robotic surgery for oropharynx cancer: promise, challenges, and future directions[J].Current Oncology Reports, 2012, 14(2): 148–157.
[7] Weinstein G S, O'Malley, Bert W, et al. Transoral robotic surgery for advanced oropharyngeal carcinoma[J]. Arch Otolaryngol Head Neck Surg, 2010, 136(11): 1079.
[8] Sharma A, Patel S, Baik F M, et al. Survival and gastrostomy prevalence in patients with oropharyngeal cancer treated with transoral robotic surgery vs chemoradiotherapy[J]. JAMA Otolaryngol Head Neck Surg, 2016, 142(7): 691–697.
[9] Mercante G, Ruscito P, Pellini R, et al. Transoral robotic surgery (TORS) for tongue base tumours[J].Acta Otorhinolaryngologica Italica, 2013, 33(4): 230–235.
[10] Mcleod I K, Melder P C. Da Vinci robot-assisted excision of a vallecular cyst: a case report.[J].Ear Nose & Throat Journal, 2005, 84(3): 170–172.
[11] O'Malley B W, Weinstein G S, Snyder W, et al. Transoral robotic surgery (TORS) for base of tongue neoplasms[J].The Laryngoscope, 2006.DOI: 10.1097/01.mlg.0000227184.90514.1a.
[12] Kayhan F T, Yigider A P, Koc A K, et al. Treatment of tongue base masses in children by transoral robotic surgery[J].European Archives of Oto-Rhino-Laryngology, 2017, 274(9): 3457–3463.
[13] Yeh DH, Tam S, Fung K, et al. Transoral robotic surgery vs. radiotherapy for management of oropharyngeal squamous cell carcinoma-A systematic review of the literature[J].European Journal of Surgical Oncology, 2015, 41(12): 1603–1614.
[14] Möckelmann N, Busch C J, M ü nscher A,, et al. Timing of neck dissection in patients undergoing transoral robotic surgery for head and neck cancer[J]. Eur J Surg Oncol, 2015, 41(6): 773–778.
[15] Loon J W L V, Smeele L E, Hilgers F J M, et al. Outcome of transoral robotic surgery for stage I-II oropharyngeal cancer[J].European Archives of Oto-Rhino-Laryngology, 2014, 272(1): 175–183.
[16] Chia S H, Gross N D, Richmon J D. Surgeon Experience and complications with transoral robotic surgery (TORS)[J]. Otolaryngology-Head and Neck Surgery, 2013, 149(6): 885–892.
[17] Dabas S, Dewan A, Ranjan R, et al. Transoral robotic surgery in management of oropharyngeal cancers: a preliminary experience at a tertiary cancer centre in India[J].International Journal of Clinical Oncology, 2014, 20(4): 693–700.
[18] Smith R V, Schiff B A, Garg M, et al. The impact of transoral robotic surgery on the overall treatment of oropharyngeal cancer patients[J]. Laryngoscope, 2015.DOI: 10.1002/lary.25534.
[19] Dziegielewski P T, Teknos T N, Durmus K. Transoral robotic surgery for oropharyngeal cancer: long-term quality of life and functional outcomes [J]. JAMA Otolaryngol Head Neck Surg, 2013, 139(11): 1099–1108.
[20] Sethi R K V, Chen M M, Malloy K M. Complications of transoral robotic surgery[J].Otolaryngologic Clinics of North America, 2020, 53(6): 1109–1115.
[21] Hay A, Migliacci J, Karassawa Zanoni D, et al. Haemorrhage following transoral robotic surgery[J]. Clin Otolaryngol, 2018, 43(2): 638–644.
[22] Su H K, Ozbek U, Likhterov I, et al. Safety of transoral surgery for oropharyngeal malignancies: an analysis of the ACS NSQIP[J].The Laryngoscope, 2016, 126(11): 2484–2491.
[23] Kubik M, Mandal R, Albergotti W, et al. Effect of transcervical arterial ligation on the severity of postoperative hemorrhage after transoral robotic surgery[J].Head & Neck, 2017, 39(Suppl 1): 1510–1515.
[24] Sharbel D, Abkemeier M, Sullivan J, et al. Transcervical arterial ligation for prevention of postoperative hemorrhage in transoral oropharyngectomy: systematic review and meta-analysis [J]. Head & Neck, 2021, 43(1): 334–344.
[25] Gleysteen J, Troob S, Light T, et al. The impact of prophylactic external carotid artery ligation on postoperative bleeding after transoral robotic surgery (TORS) for oropharyngeal squamous cell carcinoma[J].Oral Oncology, 2017.DOI: 10.1016/j.oraloncology.2017.04.014.
[26] Mann G, Hankey G J, Cameron D. Swallowing function after stroke: prognosis and prognostic factors at 6 months[J].Stroke, 1999, 30(4): 744–748.
[27] Finestone H M, Foley N C, Woodbury M G, et al. Quantifying fluid intake in dysphagic stroke patients: a preliminary comparison of oral and nonoral strategies[J].Arch Phys Med Rehabil, 2001, 82(12): 1744–1746.DOI: 10.1053/apmr.2001.27379.
[28] Smithard D G, O'Neill P A, England R E, et al. The natural history of dysphagia following a stroke[J].Dysphagia, 1997, 12(4): 188–193.

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