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European surgical guidelines: transoral robotic surgery for head and neck cancers

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ABSTRACT

Background: Substantial heterogeneity in practice exists across centers regarding the indications and perioperative care for patients undergoing transoral robotic surgery (TORS) for head and neck cancer. This consensus paper aims to propose a European surgical practice guideline in this setting.

Methods: Twenty-two experts from European and International scientific societies participated in a modified Delphi process for rating and validating statements about indications, contraindications, surgical outcomes, and pre- and postoperative care associated with TORS for head and neck cancer care. Consensus was deemed to have been achieved when two-thirds of experts agreed or strongly agreed with the statement; those with fewer than one-third agreement were improved and resubmitted for voting until final validation or rejection.

Results: Of the initial 41 statements, 38 reached consensus after three voting rounds. Statements propose recommendations for the preoperative assessment (n = 7), indications and contraindications for TORS in oropharyngeal, laryngeal, and hypopharyngeal primaries (n = 10), surgical outcomes to be reported (n = 7), postoperative care (n = 8), and clinical research (n = 6). TORS is appropriate for small, accessible oropharyngeal and supraglottic tumors with favorable exposure. The contraindications set out in detail for oropharyngeal, laryngeal and hypopharyngeal lesions will assist in decision-making, especially when presented with a controversial clinical scenario. Standardized reporting of surgical, functional, and oncological outcomes, including swallowing, voice quality, and survival rates, is essential for evidence-based practice. TORS represents a promising avenue for therapeutic de-escalation in HPV-positive oropharyngeal cancers.

Conclusion: The European TORS surgical consensus provides clinical recommendations for the indications, contraindications, surgical and perioperative care for TORS management of head and neck malignancies.

Introduction

The development of robotic and endoscopic minimally invasive technologies has facilitated a transition from open surgery to minimally invasive head and neck surgery in the past two decades [1,2]. In head and neck oncology, the da Vinci robot (Intuitive Surgical®, Sunnyvale, USA) is primarily used for the treatment of cT1-T2 and selected cT3 oropharyngeal [3,4] primaries, selected recurrent cancers [5], cT1 and cT2 supraglottic cancers [6], carcinoma of unknown primary [7] and parapharyngeal space tumors [8]. Although there are limited randomized controlled trials comparing open/endoscopic versus transoral robotic surgery (TORS) approaches, TORS appears to be associated with comparable or better functional and surgical outcomes, while reporting similar oncological outcomes [9,10]. However, to date, there is substantial heterogeneity across studies and centers regarding the indications, technical and surgical features, and perioperative evaluation and care, which limits the ability to compare published data.

The aim of this paper was to propose a European Surgical Consensus for indications, contraindications, surgical outcomes, perioperative evaluations, and care of TORS in head and neck cancers.

Materials and Methods

A modified Delphi approach was used to generate the consensus guidelines [11]. Three scientific societies, European Head and Neck Society (EHNS), European Laryngological Society (ELS), and the European section of the Young Otolaryngologists of the International Federation of Otorhinolaryngological Societies (IFOS) were approached to propose a balanced list of experts for the consensus. Experts were defined as surgeons who had a current and active TORS practice and were involved in clinical research in the field. Experts were invited to vote anonymously on a series of proposed statements through SurveyMonkey® (San Mateo, California, USA). This European surgical consensus addresses indications, contraindications, surgical outcomes, and perioperative care for TORS across laryngeal, oropharyngeal, and hypopharyngeal cancers, thereby complementing rather than duplicating the recent American consensus that focused specifically on multidisciplinary management of oropharyngeal cancer [4].

Consensus statement generation

Statement generation was performed based on literature searches and the experience of the core group. PubMed, Cochrane Library, and Scopus database literature searches were conducted by two authors (J.R. L., S.H.) for relevant peer-reviewed publications related to TORS indications and surgical outcomes published in English-language journals using MeSH (Carcinoma; Robot; Surgery; Oncology; Cancer; Outcomes) and non-MeSH (Transoral Robotic; Indications; Contraindications) keywords. The literature search was conducted according to the PRISMA Statements [12]. Relevant publications were identified, and references of the included papers were further screened for additional research. The two experts reviewed each of the abstracts and selected articles for further review. The literature was reviewed by a core group comprising three members (JRL, SH, CS), one from each of the scientific societies. The core group distilled data from the literature review and wrote and refined a list of statements for the guidelines according to the remit. Each statement was accompanied by a free text box for comments.

Grades of evidence

Each statement was assigned a grade of evidence by the core group based on the GRADE system [13], which provides a practical indication of the likely impact of future research on confidence in the estimate of effect. The committee proposed the following grading: High (A): future investigations are unlikely to change our confidence in the estimate of effect; Moderate (B): future investigations are likely to have an important impact on our confidence in the estimate of effect and may change the estimate; Low (C): future investigations are likely to have an important impact on our confidence in the estimate of effect and are very likely to change the estimate; Very Low (D): any estimate of effect is uncertain.

Voting rounds and discussion

A maximum of four voting rounds was agreed, organized by the first author (JRL) and a non-voting biostatistician (GB). To identify non-respondents and send reminder emails, the first author had access to voting results from each round. To avoid bias from viewing other responses, the first author completed their vote first before accessing the results. The core group discussed and revised non-validated statements between each voting round. Experts were allowed to complete each round of the survey once. Experts rated statements on a Likert scale, from 1 (strongly disagree) to 4 (strongly agree). The responses were collected from the survey system, and the analysis of the results of the

voting rounds was carried out by the first author and the biostatistician, who were blinded to the experts' identity.

Consensus was deemed to have been reached when two-thirds of experts agreed or strongly agreed with the proposition. Statements with fewer than one-third agreement were improved and resubmitted for voting until final validation or rejection. The statements requiring modifications were modified by the core committee composed of the 3 members proposed by the scientific societies (SH, MR, CS) and the first author (JRL). During each round of discussion, the level of agreement was communicated to the panel of experts. Statements that returned with only 33.3 to 66.6 % of scores rated 3 or 4 were discussed and revised, based on the feedback and comments provided by the voting panel. The statements that achieved consensus were banked, and those that were revised by the expert panel moved on to the next voting round. Statements that did not receive a rating of 3 or 4 from at least 33.3 % of experts were discarded.

Endorsement

The results of the Delphi process and the present publication were endorsed by the ELS, YO-IFOS and EHNS as the European surgical practice consensus for the indications, pre- and postoperative assessments of transoral robotic head and neck surgery.

Results and discussion

The voting panel included 22 experts from 11 European countries. The demographic data of experts and their related clinical and scientific background are described in Appendix 1. The Delphi process lasted 8 months and included 3 voting rounds. The mean clinical experience of experts was 17.8 (standard deviation: 9.5 years), with the expert group having performed a mean of 164.7 (standard deviation: 127.1) TORS procedures in their career to date. All data in the paper apply to TORS using the classical, S, Si, and Xi Da Vinci robot (Intuitive Surgical®, Sunnyvale, USA). Of the 41 initial statements, 38 were accepted after three voting rounds (Fig. 1). Statements propose recommendations for the preoperative assessment (n = 7), indications and contraindications for TORS procedures for oropharyngeal, laryngeal, and hypopharyngeal cancer (n = 10), surgical outcomes to systematically report (n = 7), postoperative care (n = 8), and clinical research (n = 6).

The preoperative assessment

The preoperative assessments for da Vinci-assisted TORS are similar to those used for open and endoscopic head and neck surgeries [14]. However, experts agreed that some particularities related to TORS in the preoperative work-up needed mention. The preoperative work-up is set out in seven statements in Table 1. Because the success of TORS depends on the exposure of the tumor, the experts proposed that the following factors be evaluated before patients are deemed suitable for TORS: mouth opening, dental status, mandibular anatomy, weight (obesity), oropharyngeal anatomy and space (Mallampati score), and neck anatomy. The selection of these factors corresponds to the literature, which identifies the predictive failure factors of TORS for benign and malignant conditions: overweight [15], trismus [16], and some anatomical findings commonly summarized as the six "Ms": microstomia, micrognathia, mandibulo-maxillary abnormalities, macroglossia, restricted cervical mobility, and mouth opening [17,18]. Consistent with the literature, and based on their clinical experience, all these conditions were recommended as contraindications for TORS. Importantly, although experts considered patients with obesity at risk of not being suitable for TORS, this point remains controversial, with some studies reporting that only morbid obesity could affect exposure [15,17], while others assert that it is not an absolute contraindication, especially if patients have no other limiting conditions [19]. Considering the subjective nature of preoperative assessment and variation in surgical skill sets, the expert panel recommended placing the tongue/mouth retractor during the preoperative panendoscopy for evaluating exposure. In all cases, patients deemed suitable for TORS need to be informed of the risk of conversion to open surgery or the possibility of primary non-surgical treatment. Given the aging demographic in the Western hemisphere [20], the present consensus proposes a statement for older adult patients (>70 years old), comprising of a comprehensive evaluation to assess their physiologic age and perioperative risks related to malnutrition and comorbidities. This recommendation aligns with the potential benefit of using TORS rather than radiotherapy in elderly patients regarding the postoperative swallowing sequelae associated with radiation [21].

Finally, consistent with open and endoscopic surgery recommendations [14], experts recommended the performance of contrast-enhanced computed tomography for supraglottic laryngeal and piriform sinus cancers, and both contrast-enhanced computed tomography and

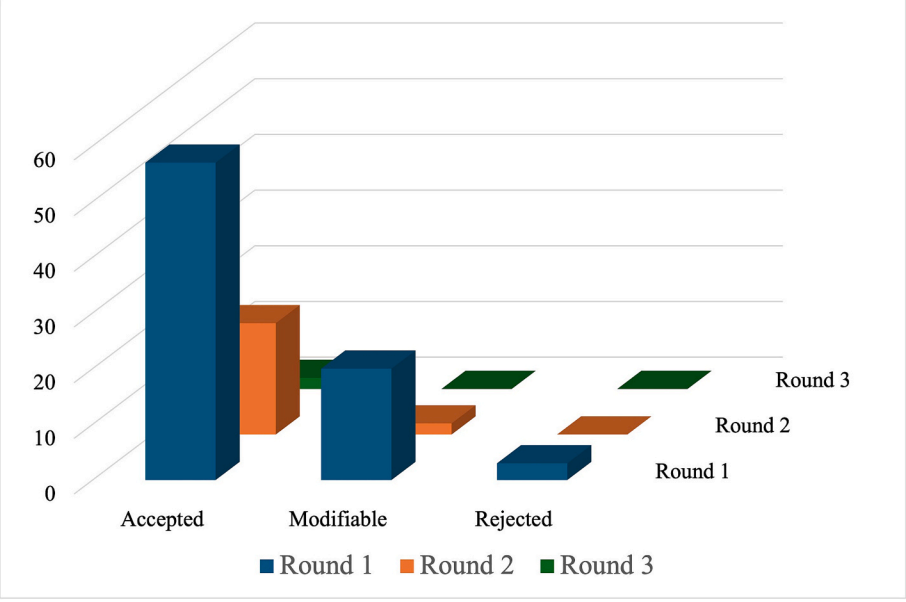

Fig. 1. Acceptation, Modification, and Rejection of Statements Throughout the Delphi Rounds. The statement acceptation rates were 71.3%, 90.1%, and 100% for rounds 1, 2, and 3, respectively.

Table 1
Preoperative assessment.

		Round	%	GRADE
1.	The oncological assessment for tumor grade and stage is similar to the open surgical approach and needs to adhere to the international recommendations.	1	100	A
2.	In cases with a risk of exposure difficulty, a tongue/mouth retractor can be placed during the preoperative panendoscopy to assess the exposure.	1	100	B
3.	All patients with an indication for TORS should be informed about the risk of conversion to open surgery, and patients must provide informed consent.	1	68.2	A
4.	A specific consultation is required for older adult patients before proposing TORS, considering chronological age (> 70 years old) and physiologic age, comorbidities, perioperative risks, nutritional status, addiction history, sarcopenia, immunological status, and significant comorbidities (including hematological, metabolic, neurological, cardiac, pulmonary, renal and hepatic disorders).	1	68.2	B
5.	Exposure needs to be evaluated prior to indicating transoral surgery. The exposure evaluation may consist of an assessment of:			
	−Mouth opening.	1	100	A
	−Dental status.	1	95.5	A
	−Mandibular anatomy.	1	86.4	B
	−Thyromental distance.	2	72.7	C
	−Body mass index (morbid obesity).	2	86.4	C
	−Oropharyngeal anatomy and space (Mallampati score).	1	90.1	B
	−Neck anatomy (shortness, thickness, neck extension/flexion).	1	100	C
6.	Contraindications and limitations of TORS may include the following conditions associated with limited exposure:			
	−Micrognathia.	1	72.7	B
	−Microstomia.	1	81.8	C
	−Trismus.	1	86.4	B
	−Significant neck rigidity.	1	68.2	B
7.	The following imaging studies are mandatory before TORS for assessment of anatomy and tumor invasion:			
	−CT scan for supraglottic laryngeal cancer.	1	81.8	A
	−CT and MRI for oropharyngeal cancer and posterior pharyngeal wall hypopharyngeal cancer.	1	86.4	A
	−CT scan for piriform sinus cancer.	1	77.3	A
	−MRI for tumors with suspected invasion of the retropharyngeal fascia and lateral structures beyond the constrictor muscle (parapharyngeal space).	2	86.4	B
	−PET-CT for unknown primary cancer requiring bilateral tonsillectomy and tongue base resection in two surgical times.	2	81.8	B

Abbreviations.
TORS = transoral robotic surgery; CT = computed tomography; MRI = magnetic resonance imaging; PET-CT = positron emission tomography-computed tomography; BMI = body mass index.

magnetic resonance imaging for oropharyngeal malignancies in the preoperative workup. The recommendations about the usefulness of PET-CT for unknown primary neck malignant adenopathy similarly align with existing evidence-based literature [22,23].

Indications and contraindications

Oropharyngeal cancers

The expert panel agreed upon 8 contraindications for TORS in oropharyngeal carcinoma (Table 2). Among them, some contraindications match the current contraindications of open oropharyngectomy,

Table 2
Indications and Contraindications.

		Round	%	GRADE
1.	For oropharyngeal cancer, TORS can be indicated for:			
	−cT1-T2 cancers.	1	100	A
	−selected cT3 cancers.	2	95.5	B
2.	TORS is particularly indicated for HPV+ (tobacco- and alcohol-negative) oropharyngeal cancer, leading to potential postoperative de-escalation of additional treatments.	1	90.1	B
3.	The primary contraindications of transoral robotic oropharyngectomy can be defined in the preoperative analysis of imaging and they may include:			
	−Tumor with invasion of the carotid artery.	1	100	A
	−Tumor requiring resection of more than 50 % of the tongue musculature.	1	100	A
	−Tumor infiltration of extrinsic tongue muscles (e.g., styloglossus or stylopharyngeus) with > 50 % of the base of the tongue, or > 50 % of the soft palate.	2	86.4	B
	−Tumor requiring ligation of both lingual arteries.	1	95.5	A
	−Tumor of the posterior oropharyngeal wall requiring the resection of more than 50 % of the posterior oropharyngeal wall and a related free flap is a relative contraindication.	2	72.7	B
	−cT4a, cT4b tumor, M+, cN3c+, or tumor with extension to the prevertebral fascia, mandible or hyoid, and the Eustachian tube.	1	90.9	B
	−cTNM staging leading to postoperative chemoradiation targeting the primary tumor site, not only the nodal region.	2	77.3	B
	−Extensive invasion of the parapharyngeal space.	1	81.8	B
4.	For laryngeal cancer, the benefits of TORS versus TOLM may be achieved for:			
	−cT1-T2 supraglottic laryngeal cancers (epiglottis, aryepiglottic fold, false vocal cords).	1	100	B
	−cT3 tumors with an invasion of the pre-epiglottic space allowing the complete resection of the tumor (at least 1 cm between the hyoid bone and the resection margin).	2	95.5	C
5.	The primary contra-indications of primary transoral robotic supraglottic laryngectomy can be defined in the preoperative imaging analysis and they may include:			
	−Invasion of the arytenoid cartilages.	1	86.4	B
	−Invasion of more than 50 % of the pre-epiglottic space with < 1 cm between the hyoid bone and the resection margin.	2	86.4	C
	−Invasion of the paraglottic space (the space between the vocal fold and the ventricular band at the horizontal plane).	3	80.0*	C
	−cTNM staging necessitating postoperative chemoradiation to the primary tumor site (not solely for nodal disease).	2	86.4	B
	−Invasion of the posterior commissure or cricoid.	1	100	B
6.	For laryngeal cancer, the benefits of TORS remain poorly demonstrated for the following anatomic locations and tumors:			
	−Vocal fold.	1	95.5	B
	−Arytenoid.	1	81.8	B
	−Retrocricoid.	1	100	B
	−Subglottic tumors.	1	90.9	B
	−cT4 laryngeal cancers.	1	100	B
7.	The primary contra-indications of primary transoral robotic hypopharyngeal cancer can be defined in the preoperative imaging analysis and they may include:			
	−Tumor reaching the prevertebral plane, or the parapharyngeal region.	2	95.5	B
	−Tumor invading the cricopharyngeal muscle.	2	77.3	B

(*continued on next page*)

Table 2 (*continued*)

		Round	%	GRADE
	−Tumor located below the horizontal plane of the arytenoid cartilages.	3	80.0*	C
	−Piriform sinus tumor invading the larynx.	2	77.3	B
	−all cT3 and cT4 hypopharyngeal carcinomas.	2	77.3	B
8.	Transoral robotic total laryngectomy has not demonstrated superiority to open total laryngectomy.	1	100	B
9.	The usefulness of the Single-Port Da Vinci robot for limited vocal fold, arytenoid, and retrocricoid tumors remains poorly investigated.	1	100	B
10.	Regardless of the anatomical cancer location, TORS is not recommended in case of cT3-T4 cancer requiring postoperative radiation/ chemoradiation.	1	81.8	B

*Two skipped responses Abbreviations: TORS = transoral robotic surgery; HPV = human papillomavirus; TOLM = transoral laser microsurgery; cT = clinical tumor stage; cN = clinical nodal stage; M = metastasis; TNM = tumor-node-metastasis.

including tumors requiring the resection of more than 50 % of tongue musculature or soft palate or tongue base, requiring the ligation of both lingual arteries, and tumors invading the carotid artery [24]. Given the advantages related to the minimally invasive transoral approach, experts judged inappropriate the use of the da Vinci robot for the resection of more than 50 % of the posterior pharyngeal wall because such resection requires a free-flap procedure and the consequent need for an open approach. Indeed, TORS commonly allows access for oropharyngeal resection without pharyngotomy or mandibulotomy, maintaining the critical muscular framework of the oropharynx and laryngopharynx necessary to preserve swallowing function [25,26]. Similar logic may be applied for cT4b, cN3b, or tumors extending to the pre-styloid parapharyngeal space, hard palate, nasopharynx, prevertebral fascia, and Eustachian tube, which are associated with poor prognosis [27], or, for extensive nodal disease (cN3) tumors, associated with a prognosis depending on neck treatment rather than tumor (TORS) resection [28,29]. Experts recommended exclusion of large oropharyngeal tumors invading the parapharyngeal space. However, a growing literature supports the feasibility and safety of TORS for cT1-T2 oropharyngeal cancer with moderate invasion of the parapharyngeal spaces [30–32], although standardized criteria to define the acceptable extent of invasion have yet to be established. Based on these contraindications, experts concluded that TORS was indicated for cT1-T2 oropharyngeal cancer, and some selected cT3, in patients without general contraindication (Table 2), which corroborates the findings of the largest cohort studies available in the current literature [4,5,33–36]. The large majority of experts believed that TORS is not an option for cT4 oropharyngeal cancer with or without mandibular bone invasion.

Laryngeal cancers

The primary indications of TORS for laryngeal cancer are cT1-T2 supraglottic laryngeal cancers located in the epiglottis, aryepiglottic fold, and false vocal cords. Experts agreed that TORS was indicated in selected patients with cT3 disease, particularly for tumors with partial invasion of the pre-epiglottic space, where at least 1 cm margin was available between the hyoid bone and the resection margin, thus allowing complete resection of the tumor (Table 2). From an anatomical standpoint, high agreement was found for TORS being contraindicated in tumors invading arytenoid and cricoid cartilages, the posterior commissure of the larynx, and when more than 50 % of the pre-epiglottic space was involved, when the distance between the hyoid bone and resection margin would be < 1 cm. As expected, cT4 laryngeal cancer, subglottic, and glottic cancers were considered as absolute contraindications for TORS. Although TORS total laryngectomy has been described [37], TORS is contraindicated for cT4 disease because of the following reasons: the longer operative time [38], higher complication rates [39], and risk of positive margins as strap muscles are not resected [40]. The expert panel concluded that these rendered TORS total laryngectomy inferior to open total laryngectomy [38,40]. These consensus statements on this topic of the present consensus corroborate the findings in the literature. A recent systematic review of surgical, functional and oncological outcomes of TORS for laryngeal cancer reported that the consideration of cT1-T2, and some selected cT3 supraglottic cancers, and the exclusion of cT4, is associated with comparable surgical and functional outcomes to conventional open and endoscopic approaches, while TORS was associated with better oncological outcomes than endoscopic and open supraglottic laryngectomies [6,42]. These favorable outcomes were found for studies including cT1 (39.1 %), cT2 (46.9 %), and selected cT3 (7.7 %) consisting of resectable tumors located in the epiglottis, false vocal cords, and aryepiglottic folds [6,42], which support the indications of the present consensus paper. During the consensus development process, experts debated the degree of invasion of the pre-epiglottic space. In a cohort study of 75 patients, Hans *et al.* indicated TORS supraglottic laryngectomies for tumors with pre-epiglottic space invaded by less than 50 % [42], while others contraindicated the use of TORS for tumors with more than 20 mm of pre-epiglottic space/base of tongue mucosa invasion [43,44].

Hypopharyngeal cancers

The emerging literature about transoral robotic hypopharyngectomy encouraged the core group to recommend indications and contraindications for TORS hypopharyngectomy. Based on the current literature [45–48], the panel proposed TORS for cT1-T2 hypopharyngeal cancer located above a horizontal cricoid plane, without invasion of the prevertebral fascia, parapharyngeal region, cricopharyngeal muscle, and larynx (Table 2). These indications and contraindications corroborate the findings of the GETTEC group study (n = 57 patients) where 51 % and 47 % of hypopharyngeal cancers treated with TORS were cT1 and cT2 tumors primarily located in the anterior piriform sinus (30 %), medial wall (35 %), and lateral wall (35 %) [47]. In this cohort, 23 % of tumors had extension to extra-hypopharyngeal subsites, leading to partial resection of the arytenoid (14 %), epiglottis (14 %), and base of tongue (2 %). Although the present consensus focuses on indications and contraindications for classical, S, Si, and Xi Da Vinci robots, the development and progressive spread of the Single-Port Da Vinci robot may lead to further revisions of indications for TORS hypopharyngectomy because its configuration is particularly adapted for reaching the hypopharynx, providing valuable insights into the resection of hypopharyngeal cancers [48,49].

Surgical, oncological and functional outcome recommendations

Historically, clear margins for oropharyngectomy were defined as 5 mm or greater, while ongoing trials and institutional guidelines have been defining clear margins as 2 or 3 mm [50,51]. Based on the literature, the panel recommended adopting surgical margins of at least 3 mm for HPV + cancers. This threshold is supported by several studies and a recent *meta*-analysis demonstrating that the margin status of TORS oropharyngectomy for HPV + cancer, including close margin (< 3 mm), does not influence the overall survival and recurrence-free survival outcomes [50,52,53]. To date, the optimal margins for HPV- cancers remain unestablished [52], which explains why the panel did not provide specific margins for TORS for HPV- cancers (Table 3). The application of 3 mm margins for supraglottic HPV + cancer was supported by adequate oncological outcomes in TORS supraglottic laryngectomy studies [6,41,42], and the potential retraction of surgical specimens, limiting the pathological analysis of margins [54].

Experts recommended starting the surgery with neck dissection and identification of external carotid branches, which can be easily accessed in the event of intraoperative hemorrhage. However, the present consensus did not reach agreement for prophylactic vessel ligation. A

Table 3
Surgical Outcomes of Classical, S, Si, and Xi da Vinci systems.

		Round	%	GRADE
1.	Regardless of the anatomical location of the tumor, TORS surgical margins of 3 mm are adequate for HPV + oropharyngeal and supraglottic cancers.	1	90.9	B
2.	Regardless of the anatomical location of the tumor, neck dissection should be performed before TORS to control vessels that may require surgical ligation (e.g., the lingual artery, superior thyroid artery, or external carotid artery).	1	68.2	C
3.	No clear recommendations are provided for systematic vessel ligation during the procedure.	2	56.5*	C
4.	If no definitive arterial ligation is performed during neck dissection, performing neck dissection and vessel control as the first surgical step can facilitate definitive vessel ligation in the event of uncontrolled hemorrhage.	1	95.2	B
5.	Control of systolic blood pressure is crucial during TORS to reduce hemorrhage.	1	86.4	C
6.	The advantages for using TORS compared to open approaches consist of:			
	−Improved 3D visualization and instrument movements.	1	100	A
	−The possibility of avoiding perioperative tracheotomy (when potential contralateral neck dissection is performed in a second surgical time).	1	72.7	B
	−Prevention of extrinsic laryngopharyngeal muscle damage resulting in rapid resumption of oral diet.	1	77.3	B
	−Shortened operative time compared to external approaches.	1	95.5	B
	−Avoiding mandible split for appropriate surgical candidates.	2	86.4	B
	−Shortened hospital stay.	2	77.3	B
	−Elimination of surgeon tremor.	1	81.8	A
	−Potential for de-escalation therapeutic protocols.	1	86.4	B
7.	The advantage for using TORS to reach higher percentage of negative surgical margins is suggested in many studies but requires future controlled studies.	2	86.4	B

*56.5 % of experts judged that vessel ligation should be avoided, when possible (notably the external carotid artery), as preserved vessels may become critical for microvascular free flap reconstruction if tumor recurrence occurs. Abbreviations: TORS = transoral robotic surgery; HPV = human papillomavirus; 3D = three-dimensional; IV = intravenous.

study by the American Head and Neck Society study reported that 89.5 % of surgeons routinely ligated external carotid artery branches during TORS procedures [55], which was demonstrated as a key surgical step for reducing the postoperative bleeding risk [56,57]. However, prophylactic vessel ligation achieved only 56.5 % of agreement, and was, therefore, not validated. In the ASCO consensus for oropharyngeal cancers, authors stated that radiologic evaluation must identify the relationship between the tumor and carotid vessels. While external carotid branches are routinely encountered during TORS, deeper dissection may expose larger vessels, increasing hemorrhage risk. Internal carotid artery exposure requires complex reconstruction with pedicled or free tissue transfer, substantially increasing surgical morbidity [4]. The comments in the free text box indicated that there was a significant minority whose preference was to avoid vessel ligation, when possible (notably external carotid artery), as preserved vessels may become critical for microvascular free flap reconstruction if tumor recurrence occurs. Experts recommended controlling the blood pressure in the perioperative period (Table 3). Based on both the literature and their surgical experience, experts listed the following outcomes as advantages of TORS over open and potentially endoscopic approaches: improved 3D view of the surgical field [29], the possibility of avoiding tracheostomy [6,42], the preservation of extrinsic oropharyngeal and laryngopharyngeal muscles and avoidance of mandibular split for swallowing rehabilitation [29,58], shortened surgical time [6,41] and hospital stay [6,42], reduction of surgeon tremor [29], and the potential de-escalation protocols for TORS oropharyngectomy in HPV + cancer [22].

Postoperative care

Postoperative care information is rarely reported in studies despite its relative importance for functional and surgical (complications) postoperative management [6,26,36]. Experts emphasized that hemorrhage is the primary postoperative complication requiring rapid airway protection before control (Table 4). Regarding adequate postoperative functional outcomes, both feeding tube placement and tracheostomy are not mandated for all TORS cases and should be discussed according to patient comorbidities and complication risks. This statement highlights the adequate postoperative outcomes found in supraglottic laryngectomies, which commonly require preventive tracheostomy and feeding tube placement/percutaneous gastrostomy when performed through an external approach [59–61]. For transoral robotic supraglottic laryngectomies, Hans *et al.* reported that 8 % and 10.7 % of patients required postoperative tracheostomy and feeding tube placement, while none had long-term tracheostomy and percutaneous gastrostomy [6,41,42].

Most experts agreed that airway and diet status are key considerations for the discharge of patients and require careful evaluation within the 48 h following the TORS (Table 4). Antibiotic therapy was not deemed necessary for more than 24 h following TORS. Longer courses should be prescribed for patients with a high risk of infection, which reflects the practices of most head and neck surgeons [55,62,63]. The reduction of antibiotic use in TORS was identified as an additional advantage over open approaches, with most authors prescribing postoperative antibiotics for preventing skin and neck infections, and aspiration pneumonia [64]. The perioperative use of corticosteroids was recommended by 90.5 % of experts for reducing the peri- and postoperative edema and pain. The benefits of using postoperative corticosteroids were suggested by the randomized controlled trial of Clayburgh

Table 4
Postoperative Care.

		Round	%	GRADE
1.	Severe postoperative upper aerodigestive tract hemorrhage requires rapid airway protection (tracheotomy or intubation).	1	100	A
2.	Perioperative tracheotomy and feeding tube placement are not systematic and depend on patient characteristics.	1	95.5	B
3.	The patient is discharged when airway status and dietary intake are both adequate.	1	95.5	B
4.	Antibiotic therapy is not mandatory for TORS postoperative care and should be recommended based on the circumstances of the case.	1	72.7	B
5.	Peri- and postoperative IV corticosteroids may be indicated to reduce peri- and postoperative edema and pain.	1	90.5	C
6.	Postoperative evaluation of swallowing is required at 24- or 48-hours post-surgery before resuming an oral diet.	1	86.4	C
7.	Postoperative speech/voice therapy is recommended to improve the voice, speech, and swallow rehabilitation, especially in supraglottic laryngeal cancer. The duration and frequency are personalized according to the local resources, patient availability and clinical course.	1	95.5	C
8.	Twenty-four–hour monitoring is required in the intensive care unit, recovery room, or a specialized ward under the supervision of a trained team.	2	72.7	C

Abbreviations: TORS = transoral robotic surgery; IV = intravenous.

et al. who demonstrated that extended perioperative corticosteroids after TORS were safe and may allow earlier improvement in diet consistency and decreased length of hospital stay [65]. Interestingly, the authors suggested that postoperative pain appeared minimally affected by the use of intravenous corticosteroids [65]. The reduction of tongue and pharyngeal wall edema during the operative time is an additional theoretical benefit of corticosteroids. Regardless of the immediate postoperative outcomes, most experts recommended 24-hour

TORS Pre- and Post-Procedure Checklist

1.Patient Assessment (3 items)

Oncological staging (cTNM):…… O – Oncological Board Recommendation:…….

O - Geriatric consultation (if age >70 years or significant comorbidities)

O - Informed consent obtained (including risk of conversion to open surgery)

2.Exposure Evaluation (8 items)

O - Mouth opening adequacy……. O - Mallampati score:…….

O - Dental status:…… O - Mandibular anatomy particularities:…….

…… ……

O - Thyromental distance:…… O - BMI:…….

O - Neck anatomy (extension/flexion, thickness):……

O - Trial retractor placement if exposure concern: ……..

3.Imaging Completed: O – Neck CT scan O – Chest CT scan

O – MRI O – PET-CT

Comments: …….

4.Contraindications Ruled Out (4 items):

O - No carotid invasion O - <50% tongue musculature resection required

O - Not requiring bilateral lingual artery ligation O - No extensive prevertebral fascia extension

Surgeon: **Patient ID:**

PER- AND POST-OPERATIVE CHECKLIST

1.Surgical Planning and Procedure (12 items)

Neck dissection performed: Ipsilateral - Bilateral

Vessel control strategy: Ligation of external carotid - preservation of external carotid

Details:……

Tracheotomy: Yes / No Feeding tube placement: Yes / No

Surgical margins (extemporaneous/definitive): ……

Docking time: …… Console time:…… Non-robotic time:…….. Total time:……

Complications documented:……

Conversion to open (if applicable): Yes / No Blood loss: ……mL

Fig. 2. Checklist of Pre-, Per- and Postoperative Care for Transoral Robotic Surgery.

2.Immediate Recovery (0-24 hours – 4 items)

O - Airway monitoring in ICU/recovery/specialized unit
O - IV corticosteroids
O – Protocol to Control Blood pressure
O – Protocol to monitor hemorrhage risk

3. Early Postoperative Time (24-48 hours – 4 items)

O - Swallowing evaluation before resuming oral diet
O - Airway status adequate
O - Antibiotic therapy if circumstances warrant
O - Pain management optimized

4. Discharge Planning (5 items)

O - Airway status stable
O - Dietary intake adequate
O - Speech/voice therapy scheduled (if indicated)
O - Follow-up appointments arranged
O - Patient educated on hemorrhage warning signs

Surgeon: **Patient ID:**

Fig. 2. (*continued*).

monitoring of patients in the intensive care unit, recovery room, or on a specialized ward under the supervision of a trained team to prevent early postoperative complications. Based on the validated statements, a checklist for surgeons performing TORS is reported in Fig. 2.

Limitations

The primary limitations of the present consensus are that the levels of agreement are based on existing literature and reflect the available observational evidence available. The limited number of randomized controlled trials comparing TORS versus open, transoral laser microscopic procedures, or radiation therapy limits the establishment of further TORS recommendations. This consensus for indications and perioperative outcomes of TORS in head and neck oncological surgery represents an initial step toward better characterization of differences between TORS and other approaches. Some of these limitations are addressed in recommendations for further research available in Table 5.

Conclusion

The European surgical practice guidelines for indications, contraindications, and perioperative care of transoral robotic surgery provide surgical, functional, and oncological statements for the management of head and neck cancers through transoral robotic surgery. Based on the limitations in the literature, the present paper provides additional statements to improve collaborative research by adopting common and validated outcomes for TORS studies.

CRediT authorship contribution statement

Jérôme R. Lechien: . **Vinidh Paleri:** Writing – review & editing, Conceptualization. **Robin Baudouin:** Conceptualization. **Aina Brunet:** Conceptualization. **Carlos M. Chiesa-Estomba:** Conceptualization. **Erika Crosetti:** Conceptualization. **Andrea De Vito:** Conceptualization. **Giovanni Cammaroto:** Conceptualization. **Armando De Virgilio:** Conceptualization. **Nicolas Fakhry:** Conceptualization. **Wojciech Golusinski:** Conceptualization. **Heikki Irjala:** Conceptualization. **Stefan Lang:** Conceptualization. **C.Rene Leemans:** Conceptualization. **Sylvain Moriniere:** Conceptualization. **Alberto M. Saibene:** Conceptualization. **Claudio Sampieri:** Conceptualization. **Somiah Siddiq:** Conceptualization. **Vincent Vander Poorten:** Conceptualization.

Table 5
Clinical Research.

		Round	%	GRADE
1.	The following surgical outcomes should be reported in clinical studies: conversion rate, surgery duration, docking duration, margin status, tracheotomy rate and decannulation rate, feeding tube rate and time to oral diet resumption, gastrostomy rate, hospital stay duration, immediate postoperative care/medication, and short- and long-term complications.	1	100	B
2.	Swallowing needs to be evaluated considering subjective (validated patient-reported outcome questionnaires) and semi-objective evaluations (FEES or videofluoroscopy).	1	95.5	A
3.	Voice quality evaluations should be multidimensional, adhering to the European Consensus Guidelines, which recommend patient- and practitioner-related subjective evaluations, stroboscopy, and aerodynamic and acoustic measurements.	1	81.8	A
4.	Speech quality outcomes can be evaluated in oropharyngeal and supraglottic laryngeal carcinomas.	1	81.8	B
5.	Pre- and post-treatment adjuvant therapies should be carefully reported, including chemotherapy, radiotherapy, and immunotherapy.	1	100	A
6.	The following oncological outcomes need to be reported in clinical studies: 2- or 5-year overall survival, 2- or 5-year recurrence-free survival, 2- or 5-year distant metastasis, local and regional recurrence rates.	1	95.5	A

Abbreviations: FEES = fiberoptic endoscopic evaluation of swallowing; TNM = tumor-node-metastasis.

David Viros Porcuna: Conceptualization. **Sébastien Vergez:** Conceptualization. **Giovanni Briganti:** Methodology. **Antonino Maniaci:** Conceptualization. **Marc Remacle:** Supervision. **Christian Simon:** Supervision. **Stéphane Hans:** Supervision.

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Appendix 1:. Expert Characteristics

Outcomes	Results
Expert countries	
Belgium	2
Finland	1
France	4
Germany	1
Italy	4
Luxembourg	1
Nederland	1
Poland	1
United Kingdon	2
Spain	4
Switzerland	1
Experience (year, mean, SD)	17.8 ± 9.5
Number of TORS procedure in the career	164.7 ± 127.1

Abbreviations: SD = standard deviation.

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