ROBOTIC SURGERY OF THE HEAD AND NECK: STATE OF THE ART AND PERSPECTIVES

Ph.D. Thesis

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1. INTRODUCTION

The multimodality treatment arsenal for head and neck squamous cell carcinoma has been recently supplemented by transoral robotic surgery (TORS). It is a novel method to decrease treatment-related morbidity while maintaining comparable oncological results to conventional surgery and to primary chemoradiation therapy. TORS has been approved by the United States Food and Drug Administration (FDA) for T1 and T2 malignancies of the upper aerodigestive tract in December 2009. Since then, the transoral application of the daVinci Surgical System (Intuitive Surgical, Inc., Sunnyvale CA, USA) has considerably spread in Europe as well.

TORS has become well established in recent years, and is used mostly for the resection of oropharyngeal as well as of select hypopharyngeal and supraglottic tumours. It is interesting to note that the sudden shift towards first-line TORS in the U.S. has occurred despite preceding decades of declining utilization of surgery in favor of primary chemo-radiation therapy (CRT) across the majority of U.S. head and neck cancer centers. The explanation for the rapid acceptance and implementation of first-line TORS therapy in the U.S. is threefold. Most importantly, mounting skepticism – especially among head and neck surgeons – as to the net benefit of first-line CRT in terms of overall survival (OS) and quality of life (QOL) in comparison to first-line definitive surgery

for head and neck squamous cell carcinoma (HNSCC) has provided the impetus towards a shift to the latter.

Second, the widespread use of first-line CRT over the past several decades in the U.S. inevitably led to the graduation of successive cohorts of head and neck surgeons with little experience in performing open procedures for such cancers.

Third, the failure of trans-oral laser microsurgery (TOLM) to gain truly widespread popularity in the U.S. provided fertile grounds on which a novel minimally invasive technique could take hold.

By contrast, a different situation exists in continental Europe with regards to the preferred first-line treatment for OPC, hypopharyngeal and supraglottic cancer. Although primary CRT plays a significant role in the management of such tumors, first-line surgery has remained a popular option here. TOLM was incorporated into most head and neck training programs, with open resections for such cancers remaining a viable treatment option. This situation has not changed in the face of the HPV-epidemic, which has also struck Europe, with many head and neck surgeons (especially in Germany and France) still favoring surgery in such cases, whether it consists of TOLM, partial laryngeal framework surgery, lateral pharyngotomy or open resection with a lip split or mandible split.

2. OBJECTIVES

2.1. Oncologic Value of TORS for HNSCC

The goal of this work was to assess the feasibility, resection margins, safety and oncological value of TORS in patients with HNSCC. The main target population is represented by patients with T1 and T2 oropharyngeal, hypopharyngeal and supraglottic cancer, where primary chemoradiation or transoral laser surgery are feasible treatment options as well. The main purpose of transoral robotic surgery in these patients is to maintain oncologic safety while reducing treatment-related morbidity.

2.2. Functional Value of TORS for HNSCC

While maintaining oncological safety comparable to that of primary CRT or TOLM, our purpose was to achieve better postoperative swallowing function compared to primary CRT. Omitting or reducing adjuvant treatment after primary surgery is equally paramount. With better resection margin control, appropriately selected and surgically staged patients may avoid adjuvant treatment or at least reduce ajuvant radiation therapy by 10 Gy and omit the chemotherapy component.

2.3. Perspectives, Future Directions

The above trend is expected to further unfold in terms of keeping the number of treatment modalities at the minimum, without compromising oncologic safety, especially in HPV-driven tumours.

In addition to omitting or reducing adjuvant therapy, even surgery alone may become more conservative as well.

In the primary tumour sites of the upper aerodigestive tract, real-time mass spectrometry evaluation of the surgical margins from the combustion products of monopolar cautery, coupled with TORS, may avoid unnecessarily large resections.

In the outer neck, hot spot guided sentinel level superselective neck dissections (HSG SL-SSND) in appropriately staged oral cavity, oropharyngeal, hypopharyngeal, glottic and supraglottic cancer patients may reduce the extent of resection to levels IIa and III using radiotracer injection during the initial panendsocopy and SPECT-CT prior to the neck dissection.

3. METHODS

The following set of data was collected in a prospective manner for each patient underwent TORS at our institution: Case number, date of presentation, date of diagnosis, date of procedure, patient age at TORS, patient gender, cTNM-classification, pTNM-classification, overall tumor stage, tumor site, tumor side, p16-status, HPV-DNA-status, smoking pack years, alcohol history, margin status, closest margin, neck dissection levels done, nodal yield of neck dissection, number and level of positive lymph nodes, presence of extracapsular spread (ECS), adjuvant therapy, dosis of radiation in Gray (Gy) if applicable, chemotherapy, post-operative bleeding, need of tracheotomy, days intubated, intensive care unit (ICU) days, intermediate care (IMC) days, nasogastric (NG) tube days, percutaneous endoscopic gastrostomy (PEG) tube days, speech function, swallowing function, duration of follow-up, recurrence, time to recurrence and site of recurrence if applicable, alive or dead, date of death if applicable, alive with or without disease, dead with or without disease, modality of salvage if applicable, among other data concerning the technical details of the robotic procedures, i.e. which Endowrist instruments, which optic, which retractor etc. were applied for each specific procedure.

Following the above pathway, thirty-five patients with appropriately staged oropharyngeal cancer were selected for our initial robotic surgery series (Table 2). They underwent TORS between September 2011 and April 2013 (19 months' timeframe) as the primary

treatment modality along with an appropriate uni- or bilateral neck dissection, as indicated, providing the largest single-institution TORS-cohort to date in the German-speaking countries.

Another five patients underwent TORS and concurrent selective neck dissection for early hypopharyngeal cancer. In the present subset analysis, we summarize and evaluate their clinico-pathological data in order to determine whether TORS is a suitable first-line treatment for early hypopharyngeal squamous cell carcinoma.

After obtaining informed consent, all TORS-procedures and neck dissections have been performed under general anaesthesia with a transoral intubation using a reinforced, metal-coated laser-tube both cuffs blocked with air, only to provide protection from the proximity of the monopolar dissection. The surgeries were performed consistently by the same TORS-team, licensed according to the official daVinci-TORS-training pathway approved by Intuitive Surgical, Inc.

All patients have been operated using the following surgical equipment: Soft Spandex lip and buccal retractor (Ortho-Care, Saltaire, West Yorkshire, UK); exposure obtained either using the LARS- or the FK-WO-retractor system (trade names described previously); daVinci Si Surgical System being docked from the right side of the patient approximately in a 30°-angle between the patient cart and the operation table, as well as 5mm and 8mm-Endowrist instruments (Intuitive Surgical, Inc., Sunnyvale CA, US

4. RESULTS

Adjuvant treatment was completely spared in 13 OPSCC cases (37.1% of all OPSCC patients). With one exception, they have all been free of recurrent disease to date. Fourteen OPSCC patients received postoperative adjuvant radiotherapy, two of them presented with recurrence after 4 and 9 months. Five further OPSCC patients received postoperative adjuvant chemo-radiotherapy, they have all been free of recurrence to date.

At the time of the last follow-up visit (median: 13 months), 30 OPSCC patients (85,7%) had been recurrent-free and altogether 34 patients were alive as well as tumor-free in the same time. There had been a total of 5 patients (14.2%) with early recurrent disease, two of them having previously refused adjuvant treatment despite the recommendation of our multidisciplinary head and neck tumor board. One patient died of recurrent disease with distant metastasis.

Clear resection margins were achieved in all HPSCC cases. In four patients, the closest margin was ≥5mm. In one single case, the closest margin was 4mm (Table 4).

Adjuvant treatment was completely spared in 3 HPSCC cases. One patient received adjuvant radiation alone (60 Gy) for his pT2 pN0 hypopharyngeal cance. Another patient received 66Gy adjuvant chemoradiotherapy for his pT2 pN2b disease. All patients had been recurrent-free and altogether four patients were alive as well as tumor-free in the same time. One patient died of other disease (heart attack).

5. DISCUSSION

Transoral robotic surgery has several advantages over conventional endoscopic surgery of the upper aerodigestive tract, including trans oral laser microsurgery (TOLM). The latter provides with a tangential-only cutting plane due to the known line-of-sight issue, while a constant repositioning of the laryngoscope is often still necessary. As a consequence of these limitations, en bloc resection is not possible in many cases and a piece-meal technique is considered to be acceptable by a number of author.

In contrast to TOLM, TORS has an ability to perform multi-planar en-bloc tumor resections under a magnified 3D-HD-view, which enables the assessment of the resection margins to be more accurate. The greater degree of freedom of the Endowrist-instrumentation makes the margin safety of the resections equally sound to that of conventional open surgery, but on a much lower cost of surgical morbidity. This, paired with a histopathologically most reliable margin assessment due to the en bloc resection, allows TORS to match the oncological safety of open surgery with the low morbidity of endoscopic laser surgery.

From a functional point of view, numerous clinical studies have shown improved post-TORS swallowing function compared to other surgical modalities and to primary chemoradiation therapy, along with shorter hospital stay and faster recovery, as well as a more efficient return to work after completion of therapy.

6. CONCLUSIONS

TORS with functional and selective neck dissection, followed by risk-adapted adjuvant radiotherapy if indicated, are able to provide comparable oncologic outcomes to that of primary chemoradiotherapy as well as improved functional results according to the 2-year follow-up data of our patients with T1/T2 OPSCC.

Our next goal in this regard is to draw conclusions from a longer term follow-up analysis and to further reduce treatment-related morbidity by limiting the current SNDs to superselective ones including only level IIa and III in HPV-positive patients (hot-spot-guided sentinel level superselective neck dissections using SPECT), as well as to further reduce adjuvant radiotherapy below 60Gy.

To date, this TORS-study has had the highest porportion of patients who did not need adjuvant treatment, with 2-year survival outcomes comparable to that of primary CRT with documented better functional result. In well selected patients, the majority of them can be successfully treated using surgical monomodality.

Also, this is the first study to show a direct correlation between dissection technique and nodal yield of a neck dissection, an independent prognostic factor.

Further, this is the first proposal in the literature for a standardised incorporation of TORS into the multidisciplinary treatment arsenal of HNSCC, providing a therapeutic protocol with a decision making algorithm according to the actual cTNM staging of a specific patient.

7. PUBLICATIONS

7.1. Related to the Ph.D. Thesis

1. Lorincz BB, Mockelmann N, Busch CJ, Knecht R. Functional outcomes, feasibility, and safety of resection of transoral robotic surgery: Single-institution series of 35 consecutive cases of transoral robotic surgery for oropharyngeal squamous cell carcinoma. 2014, Head & Neck (online).

2. Lorincz BB, Busch CJ, Mockelmann N, Knecht R. Feasibility and safety of transoral robotic surgery (TORS) for early hypopharyngeal cancer: a subset analysis of the Hamburg University TORS-trial. 2014, European Archives of Oto-Rhino-Laryngology: Official Journal of the European Federation of Oto-Rhino-Laryngological Societies (online).

3. Lorincz BB, Knecht R. [Transoral robotic total laryngectomy and neck dissection: the concept of robotic combo surgery]. 2013, Laryngo-Rhino-Otologie; 92:585-588.

4. Lorincz BB, Laban S, Knecht R. [The development of TORS in Europe]. 2013, HNO; 61:294-299.

7.2. Other Publications

5. Lorincz BB, Mockelmann N, Knecht R. Single-incision transaxillary robotic total thyroidectomy for Graves' disease: improved feasibility and safety with novel robotic instrumentation. 2014, European Archives of Oto-Rhino-Laryngology: Official Journal of the European Federation of Oto-Rhino-Laryngological Societies (online).

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