Transoral Robotic Surgery for Head and Neck Cancer

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Role of surgery in head and neck cancer
A history of pendulum shifts

Early 20th century
- Most head and neck cancer surgery associated with unacceptable morbidity and mortality
- Radiation therapy the mainstay of treatment

Mid-20th century
- Hayes Martin, John Conley
- Modern, safe head and neck surgery
Role of surgery in head and neck cancer

1970s, 1980s

- New reconstructive techniques expanded the scope of resectability
- Pedicled vascularized flaps, free flaps

Standard surgical approaches: Principles

To maximize local control: obtain negative margins
Reconstruct complex defects with free flaps
Post-op radiation therapy for high-risk cases

Unsurpassed local control and good functional rehabilitation can be achieved

Role of surgery in head and neck cancer

1990s

- “Organ preservation” strategies through chemoradiation achieve similar oncologic outcomes as primary surgery + radiation

Early 21st Century

- Lesser role of surgery due to increased use of concurrent chemoradiation therapy
- Oral cavity
  - Primarily a surgical disease
- Oropharynx, larynx
  - Primary open surgery less common
  - Primary chemoradiation more common
Oropharynx cancer

Very high control rates for primary concurrent chemoradiation in many reported series

- **de Arruda et al (2006, MSKCC):** Stage I-IV oropharynx cancers treated with chemo-RT
  - 2 yr local control: 98%
  - 2 yr regional control: 88%
- **Huang et al (2008, UCSF):** 71 Stage III/IV oropharynx cancers, all treated with chemo-RT
  - 3 yr local control: 93%
  - 3 yr regional control: 93%
  - 3 yr locoregional control: 87%

Role of HPV?

- Half or more of all new cases
- More favorable prognosis

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Oropharynx cancer

Very high control rates for concurrent primary chemoradiation in many reported series

With cure rates >85%, suggests some patients getting overtreated

Significant long-term toxicities associated with chemoradiation treatment

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Chemoradiation for head and neck cancer

Organ preservation does not always equal function preservation

**Long-term morbidity to high-intensity chemotherapy and radiation therapy**

- Swallowing dysfunction → permanent G-tube dependence (9-30% in reported series)
- Pharyngeal strictures
- Debilitating xerostomia
- Chronic pain
- Osteoradionecrosis/chondroradionecrosis
Surgery for head and neck cancer

Nonetheless, with high survival rates now expected from chemoradiation, it is difficult to convince patients to undergo conventional radical surgery and reconstruction.

If surgery is to have a continued role in management of head and neck cancer, it must
- Provide equal or better local control rates as chemoradiation
- Offer better functional outcomes than chemoradiation
  - Better QOL, better swallowing function, lower cost, more rapid recovery

Can surgery provide better outcome than primary chemoradiation?

To improve conventional, open surgery
- Achieve more accurate and precise margins
- Use transoral approach to minimize disruption of extrinsic pharyngeal muscles
- Avoid tracheostomy
- Rapid recovery/shorter hospitalization

Transoral Robotic Surgery

Trans-Oral Robotic Surgery (TORS)
Developed at U Penn
Addresses limitations of standard transoral surgery
- Restricted surgical access
- Long instrumentation with limited functionality
- Microscopic optics outside the oral cavity
  View limited by line of sight
FDA Approval Dec 2009
- Trans-oral robotic surgery for benign and malignant diseases
Transoral Robotic Surgery

**Trans-Oral Robotic Surgery (TORS)**
- Da Vinci surgical system
- Surgeon sits at console located at a distance from patient
- Robotic cart at patient bedside

**Da Vinci Robot**
- Not actually surgery by a robot—remote control surgery a better description

**Da Vinci Robot**
- 2 laterally placed instrument arms and central video camera
- High-definition 3-D images

**5mm Instrument Arms**
- Maryland dissector
- Monopolar cautery
- Schertel grasper
- Needle driver
Transoral Robotic Surgery

**Da Vinci Robot**
- Tumor removed en-bloc
- Precision cutting with cautery or flexible CO₂ laser
- Most defects heal by secondary intention

**Da Vinci Robot: Benefits**
- Improved 3D visualization, in a small space
- Able to see around corners
- Up to 540 degrees of wristed instrumentation
- Motion scaling increases precision, eliminates tremor and fatigue

**Da Vinci Robot: Drawbacks**
- Lack of haptic or tactile feedback
- Current robotic instrumentation, not designed for H&N surgery

**Early experience with TORS**
Weinstein et al (2007, U Penn)
- 27 patients with tonsil cancer
- Negative margins achieved in all cases
- Average surgery time: 103 min
- No early local or regional recurrences
Transoral Robotic Surgery

Early experience with TORS
Genden et al (2009, Mt Sinai)

- 20 patients with oropharynx and larynx cancers
- 18/20 negative margins achieved
- No tracheotomies
- Average surgical time: 84 min
- No oncologic outcome data reported

UCSF experience (Jan 2011 – present)

- 15 cases
- 3 for diagnostic purpose or benign disease
- 12 cancer operations: all oropharynx
- 6 tonsil; 5 base of tongue; 1 soft palate
- 1 positive margin
- 1 take-back for post-operative bleeding
- Avg hospital stay: 3 days (longest 13 days)
- 4 staged neck dissections; no fistulas
- All patients have resumed their pre-op diet

TORS Radical Tonsillectomy

Indications
- T1, T2, select T3

Contraindications
- Most T4
- Tumor adjacent carotid arterial system
- Deep invasion lateral to constrictor muscles or posterior to prevertebral fascia
- Presence of retropharyngeal ICA
- Unresectable nodal disease

Technique
Use Crowe-Davis retractor
TORS Radical Tonsillectomy

Technique
- Incision lateral to anterior tonsillar pillar at the pterygomandibular raphe
- Develop plane lateral to the constrictor muscles
- Transection of soft palate and superior constrictors
- Incise the posterior pharyngeal wall
- Resection of tongue base margin
TORS Tongue Base Resection

**Indications**
- T1, T2, select T3

**Contraindications**
- Most T4
- Deep involvement of >1/2 base of tongue
- Deep invasion lateral to constrictor muscles or posterior to prevertebral fascia
- Unresectable nodal disease

TORS Tongue Base Resection

**Technique**
- Nasal intubation
- Inferior/posterior incision at vallecula
- Midline incision to establish depth of resection
- Lateral pharyngeal incision
- Superior/anterior incision at circumvallate papillae
- Deep muscle transection
- Ligation of lingual artery with hemoclips
TORS Tongue Base Resection

Indications
- T1, T2, select T3

Contraindications
- Most T4
- Bilateral arytenoid involvement
- Extension to the glottis
- Decreased vocal fold mobility
- Tongue base involvement approaching circumvallate papillae
- Inability to get adequate transoral exposure
- Severe pulmonary disease
- Prior radiation or chemoradiation to the larynx are relative contraindications

TORS Supraglottic Laryngectomy

Indications
- T1, T2, select T3

Contraindications
- Most T4
- Bilateral arytenoid involvement
- Extension to the glottis
- Decreased vocal fold mobility
- Tongue base involvement approaching circumvallate papillae
- Inability to get adequate transoral exposure
- Severe pulmonary disease
- Prior radiation or chemoradiation to the larynx are relative contraindications

Technique
- Use FK-WO retractor
- Midline transection of epiglottis
- Incise vallecula mucosa
- Dissection of thyroid cartilage
- Ligation of the superior laryngeal artery/preservation of the superior laryngeal nerve in pharyngoepiglottic fold
- Transection of the petiole of the epiglottis
- Transection of ventricular mucosa to the inner aspect of the thyroid cartilage
- Separation of specimen from the arytenoid
Do we really need TORS?

The da Vinci robot is expensive
- 2 – 2.5 million dollars / ~150K annual service contract

Most patients still need post-operative radiation therapy anyway

Patients with advanced nodal disease may still need chemotherapy

Lack of randomized clinical trial data

Do we really need TORS?

The da Vinci robot is expensive
- 2 – 2.5 million dollars / >100K annual service contract

However, hospitals unlikely to purchase robot solely for the purpose of performing TORS

Added cost of robot, per TORS case is modest
- ~$500

Shorter hospitals stays compared to open procedures

Do we really need TORS?

Most patients still need post-operative radiation therapy anyway

Role of radiation therapy in development of late swallowing complications
- Volume of radiation treatment
- Intensity of radiation treatment
Do we really need TORS?

Most patients still need post-operative radiation therapy anyway

Role of radiation therapy in development of late swallowing complications

– Volume of radiation treatment
  • Bulky, exophytic tumors extending into pharyngeal lumen lead to overtreatment of juxtaposed but uninvolved pharyngeal muscles
  – Intensity of radiation treatment

Post-operative radiation therapy after TORS

Smaller and selective planning target volumes

• Less treatment overlap to pharyngeal constrictors, other swallowing muscles

Use of lower radiotherapy doses (<60 Gy)

• Reduced dose to pharyngeal constrictors, other swallowing muscles

De-intensification of radiation therapy (smaller volume, lower dose) if negative margins and no negative pathologic features

→ De-intensification results in better preserved swallowing after TORS + RT
Do we really need TORS?

Patients with advanced nodal disease may still need chemotherapy

Post-operative indications for chemotherapy
- Positive margins
- Extracapsular extension of lymph nodes

Do we really need TORS?

Extracapsular extension of lymph nodes is poor prognostic indicator


But what is extracapsular extension is not precisely defined
- Gross soft-tissue invasion vs microscopic capsule penetration
- Radiologic vs pathologic criteria

Do we really need TORS?

Extracapsular extension of lymph nodes as poor prognostic indicator?

May depend on primary tumor site and how neck nodes are treated


- For oropharynx cancer treated surgically, ECS was not an independent predictor of poor outcome

Do we really need TORS?

Patients with advanced nodal disease may still need chemotherapy

Maybe not necessary for TORS patients who undergo comprehensive neck dissection
Do we really need TORS?

Lack of randomized clinical trial data
- The gold standard
- TORS vs chemoradiation

TORS vs Concurrent CRT

Weinstein et al (2010)— ~300 TORS cases
- Majority (88%) got post-op adjuvant therapy
  - De-intensification of radiation therapy if negative margins and no negative prognostic factors
  - Total dose to pharynx kept under 62 Gy
  - 75% avoided chemotherapy
- Same locoregional control/survival as CRT
- 2-year G-tube dependent rate: 0% for TORS
- Average cost for TORS treated patients was less than cost for standard course of chemoradiation

Role of TORS for Head and Neck Cancer

For select oropharynx and supraglottic cancers
- Adequate transoral exposure
- Safety of procedure with respect to vasculature
- Preservation of sufficient pharyngeal function for swallowing

Negative margins are key
- Permit de-intensification of adjuvant therapy