Paraglottic Space in Supracricoid Laryngectomy

Min-Sik Kim, MD; Dong-Il Sun, MD; Kyung-Ho Park, MD; Kwang-Jae Cho, MD; Young-Hak Park, MD; Seung-Ho Cho, MD

Background: Paraglottic space (PGS) is a connective tissue compartment of the larynx and is important in the extension of laryngeal cancer. It communicates with the preepiglottic space superiorly and with the extralaryngeal region inferiorly through the gap within the cricothyroid membrane. Transglottic cancer of the larynx, which spreads within PGS, is characterized by a high incidence of laryngeal skeleton invasion and of cervical metastasis. Determining the correct stage of transglottic cancer of the larynx is difficult, leading to therapeutic failure of partial laryngectomy in some cases.

Objective: To clinically confirm a pathologically complete resection of PGS from the piriform sinus mucosa by supracricoid partial laryngectomy in laryngeal cancers involving PGS.

Materials and Methods: Eight patients with transglottic cancer whose cancer was confirmed clinically and pathologically at stages T2b or higher underwent supracricoid partial laryngectomy. During supracricoid partial laryngectomy, we performed a sharp dissection of PGS from the piriform sinus mucosa to obtain a complete resection margin while preserving the piriform sinus mucosa. Microscopic evaluation of the specimens was made for the invasion of PGS and the safe margin distance from the piriform sinus mucosa.

Results: Pathological cancer invasion of PGS was confirmed in 7 of 8 patients and a sufficient pathological margin from tumor invasion to the piriform sinus mucosa was obtained. The average safety margin was 10.3 mm.

Conclusion: Supracricoid partial laryngectomy could be considered a safe surgical modality for cancers not extending to PGS.


PARAGLOTTIC SPACE (PGS) is a connective tissue compartment of the larynx and was first described in 1962 by Tucker and Smith.1 They reported that PGS borders the thyroid cartilage anterolaterally, the conus elasticus interoinferiorly, the ventricle and quadrangular membrane inferiorly, and the piriform sinus mucosa dorsally. Paraglottic space is also connected with the preepiglottic space superiorly and with the extralaryngeal space inferiorly through the gap in the cricothyroid membrane.1,2 Kirchner and Cornog3 described transglottic cancer as laryngeal cancer invading both sides of the false vocal cord and true vocal cord across the ventricle, and reported that the extension of laryngeal cancer is achieved through PGS. Transglottic cancer invading PGS is characterizedly known to show a high incidence of laryngeal skeleton invasion and cervical metastasis.4,5 Determining the accurate stage of transglottic cancer is difficult preoperatively,6 leading to failure of partial laryngectomy in some cases.6,7 Laryngeal cancer invading PGS was treated in the past with total laryngectomy; however, patients who undergo this procedure lose their voice, resulting in social and emotional problems. The development of partial laryngectomy in recent years has led to the development of surgical methods that preserve the maximal physiological function of the larynx while totally removing the primary site. Supracricoid partial laryngectomy (SCPL) is one of the methods reported that can be used in laryngeal cancer cases needing total laryngectomy by resecting the tumor with PGS.6,8 However, pathological verification in this procedure has not been established because the tumor is removed completely from the piriform sinus where no barrier is present from laryngeal cancer cases. Thus, we tried to confirm whether a tumor can be resected safely by separating PGS from the piriform sinus mucosa SCPL in locally advanced laryngeal cancer cases with preoperative PGS invasion of stage T2b or higher.
**RESULTS**

Paraglottic space invasion was confirmed histologically in 7 (9 sides) of 8 cases (10 sides) of clinically suspected PGS invasion. The safety margin from the tumor mass to the piriform sinus mucosa in the supraglottis was 3 mm in supraglottic cancer and 9 to 19 mm in glottic cancer. The invasion was mainly present in supraglottic cancer and the safety margin was maintained but was too close. Although the invasion was present in the glottic area with the safety margin of 2 mm in supraglottic cancer and 5 to 17 mm in glottic cancer, the safety margin was sufficient in most cases. The safety margin from the middle of the tumor was 15 and 17 mm in 2 of 3 cases with initial PGS invasion; 5 mm in 1 case with confirmed PGS invasion; and 2 mm, 5 mm, and 8 mm in 3 cases of T3 tumors. In 2 cases (4 sides) of T4 tumors, the safety margin was 5 mm in the right side and 6 mm in the left side in 1 case and 14 mm in the right side and 16 mm in the left side in the other case. Among these, the closest safety margin was 2 mm from the superior glottic region to the piriform sinus in the T3 transglottic tumor originated from the supraglottis (Figure 3).

In all 8 cases, PGS could be dissected from the piriform sinus mucosa with a sharp knife (Figure 1).

**TISSUE TREATMENT**

The resected tissue was fixed in 10% formaldehyde, deca
cified in 8% formic acid for 4 days, and embedded in par
affin. After cutting 4-mm horizontal sections from the top,
middle, and bottom sections of PGS, the supraglottic para
glottic region, glottic region, and infraglottic region of PGS
(by observing the embedded tissue), the invasion of PGS
was determined visually in each section. When invasion
of PGS was present, the distance between the resection mar
gin of the piriform sinus and tumor mass was measured,
and the tissue slides were prepared from the site nearest
the tumor mass and stained with hematoxylin-eosin. The
distance between the tumor mass to the piriform sinus mu
cosa was then measured and the average distances of the 3
sites were calculated (Figure 2).

**PATIENTS AND METHODS**

The study was conducted with 8 patients who were diag
nosed as having transglottic cancer at stage T2b or higher
with radiologically suspected invasion of PGS and de
creased or fixed movement of the vocal cords. These pa
tients underwent SCPL at the Department of Otolaryn
gology–Head and Neck Surgery, Kangnam St Mary’s Hospital, College of Medicine, and The Catholic University of Korea, from March to December 1999. All cases were squamous cell car
cinoma, and the primary lesion was glottic cancer in 7 cases
(9 sides) and supraglottic cancer in 1 case. The study in
cuded 2 patients with stage T4 cancer where the vocal cord
invasion of both sides was present (Table). There were 3
cases of T2b, 3 cases of T3, and 2 cases of T4 cancer; 6 cases
underwent cricohyoidoepiglottopexy; 1, tracheocricohyoid
oepiglottopexy; and 1, cricohyoidopexy. All patients were
male with an average age of 63.6 years.

**SURGERY METHODS**

Supracricoid partial laryngectomy described by Laccour
dreye et al was performed according to tumor location. Af
er dissecting the superior and nontumor-bearing side of
PGS tissue during surgery according to tumor invasion by
the conventional method, the lesion side of PGS was com
pletely dissected from the piriform sinus mucosa. To ex
pose the piriform sinus mucosa, an index finger was in
serted in the piriform sinus, pulling it anterolaterally while
pulling the other side of the larynx in the opposite direc
tion. The remaining PGS tissue, not including the pirif
form sinus mucosa, was sharply dissected completely and
the PGS tissue was removed from the piriform sinus mu
cosa with a sharp knife (Figure 1).

**TISSUE TREATMENT**

The resected tissue was fixed in 10% formaldehyde, de
cified in 8% formic acid for 4 days, and embedded in par
affin. After cutting 4-mm horizontal sections from the top,
middle, and bottom sections of PGS, the supraglottic para
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distance between the tumor mass to the piriform sinus mu
cosa was then measured and the average distances of the 3
sites were calculated (Figure 2).

**Paraglottic Space Invasion and Safety Margin From Tumor to Piriform Sinus Mucosa**

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Tumor Site</th>
<th>Tumor Stage</th>
<th>Paraglottic Space Invasion</th>
<th>Safety Margin, mm</th>
<th>Average Margin, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Clinical</td>
<td>Pathologic</td>
<td>Superior</td>
</tr>
<tr>
<td>1</td>
<td>G</td>
<td>T2b N0 M0</td>
<td>+</td>
<td>–</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>SG</td>
<td>T3 N0 M0</td>
<td>+</td>
<td>+</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>G</td>
<td>T3 N0 M0</td>
<td>+</td>
<td>+</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>G</td>
<td>T2b N0 M0</td>
<td>+</td>
<td>+</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>G</td>
<td>T3 N2b M0</td>
<td>+</td>
<td>+</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>G</td>
<td>T4 N0 M0</td>
<td>+</td>
<td>+</td>
<td>15 (R), 11 (L)</td>
</tr>
<tr>
<td>7</td>
<td>G</td>
<td>T2b N0 M0</td>
<td>+</td>
<td>+</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>G</td>
<td>T4 N1 M0</td>
<td>+</td>
<td>+</td>
<td>8 (R), 11 (L)</td>
</tr>
</tbody>
</table>

*G indicates glottic; SG, supraglottic; plus sign, invasion present; minus sign, no invasion; R, right side; and L, left side.

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that the PGS is a compartment in the larynx composed of connective tissue; it borders the thyroid cartilage anterolaterally, the conus elasticus inferomedially, the ventricle and quadrangular membrane superomedially, and the piriform sinus dorsally. The PGS connected to the preepiglottic space superiorly, to the extralaryngeal space through the gap in the cricothyroid membrane inferiorly, and included the thyroarytenoid muscle. However, Maguire and Dayal defined PGS as a small space composed of fat tissue bordering the thyroarytenoid muscle medially, the thyroid cartilage laterally, and the piriform sinus dorsally; the thyroarytenoid muscle from PGS was excluded. Sato et al reported similar results. Thus, defining the exact area of PGS is still debatable. The inferior PGS located between the medial thyroarytenoid muscle and lateral thyroarytenoid muscle plays an important role in decreasing the vocal cord and arytenoid movements as the route of glottic cancer extension. In other words, a decrease in the vocal cord movement represents the invasion of a tumor into the medial thyroarytenoid muscle through PGS in supraglottic cancer, and invasion into PGS of a tumor through the medial thyroarytenoid muscle in glottic cancer. In the present study, we confirmed that of 8 patients with suspected tumor invasion into PGS clinically and radiologically, 7 patients experienced tumor invasion into PGS histologically.

Transglottic cancer is laryngeal cancer invading the false vocal cord and true vocal cord across the ventricle. The origin of this tumor could be glottic cancer progressing superiorly, supraglottic cancer extending inferiorly, or a tumor originating from the ventricle extending into both directions. Clinical characteristics of this cancer are submucosal extension of the false vocal cord, PGS invasion, cartilage invasion, and cervical lymph node metastasis in about 30% to 40% of cases. Hao et al compared a T3 tumor invading only the true vocal cord with T3 transglottic cancer and reported that transglottic cancer showed more cervical lymph node metastasis, with 27% compared with 17% in the T3 tumor; there was more extracapsular spread in transglottic cancer with 43% compared with 27%. Also, Biller and Lawson reported that vertical partial laryngectomy could result in incomplete resection in transglottic cancer and could cause a high rate of recurrence. Transglottic cancer extends usually through PGS; thus, total laryngectomy was performed to completely remove PGS when a tumor invaded the PGS due to a high failure rate with past conventional methods of partial laryngectomy. However, total laryngectomy results in loss of voice and creates serious emotional and social problems for the patient. Therefore, it is important to accurately determine the presence or absence of PGS invasion preoperatively for the selection of treatment method and operative results.

Zbären et al reported that PGS invasion can be diagnosed accurately in 86% of cases with computed tomography and in 89% with magnetic resonance imaging. We clinically determined the presence or absence of PGS invasion using computed tomography when the vocal cord movement was decreased or fixed. Laccourreye et al recently reported on SCPL to remove PGS, epiglottis, and preepiglottic space, including thyroid cartilage. Different from total laryngectomy, this procedure not only avoids
Supracricoid partial laryngectomy is a procedure that permits a safe en bloc dissection of a tumor including PGS when the tumor is confined within the PGS and could be used more effectively by safely separating PGS from the piriform sinus mucosa while managing to preserve the piriform sinus mucosa. This procedure needs to be performed after more prudent evaluation and selection in patients with transglottic cancer originating from the supraglottis.

CONCLUSIONS

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REFERENCES


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