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The prognostic value of abnormal findings on radiographic swallowing studies after total laryngectomy

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Abstract

Pharyngocutaneous fistulae are a common complication after total laryngectomy. Our study evaluates the correlation of postoperative radiographic swallowing studies and clinical symptoms. We also propose a grading system to classify leaks radiographically. The records of 45 patients who underwent total laryngectomy were retrospectively reviewed. All patients had a radiographic swallowing study (RSS) on or around the tenth postoperative day. A grading system was developed to classify radiographic findings (grade 0–5). Twenty-two patients had an abnormal RSS (grade 2–5). Three patients (13.6%) had clinical signs of impending fistula whereas radiography showed moderate leakage (grade 3) in one patient and a pharyngocutaneous fistula (grade 5) in two. The other 19 patients with radiographically demonstrated leakage had no clinical signs of anastomotic complications. After total laryngectomy, radiography may reveal anastomotic complications of varying severity. The grading system used in this study enabled us to objectively classify the radiological abnormalities on swallowing studies. Because most radiographic leakages were clinically silent and not all clinically apparent fistula were radiographically visible in our study, the role of routine postoperative radiographic swallowing studies in the absence of clinical signs or fistula remains unclear.

Keywords: Laryngectomy; fistula; anastomosis; radiographic swallowing studies; imaging.

Introduction

Pharyngocutaneous fistulae are the most common complications after major laryngeal and/or hypopharyngeal ablative surgery. The reported incidence of pharyngocutaneous fistula varies from 0.6% to 32%^[1–14]. Pharyngocutaneous fistulae after laryngectomy occur when there is a breakdown or inadequate closure of the suture line.^[2,4] It presents with wound erythema, followed by skin slough and salivary flow through a cutaneous orifice. The presence of a fistula will usually become clinically apparent 7–11 days after surgery.^[15] Low-grade fever, odour, oedema of the skin, saliva in the suction tube, or pain on palpation of the neck should alert the surgeon to the development of a fistula.^[5]

The development of pharyngocutaneous fistula delays wound recovery, the beginning of oral intake,

and voice rehabilitation. Furthermore, a large fistula may prolong hospitalization and postpone the start of postoperative radiotherapy, which may adversely affect local regional tumour control.^[14] In addition, the likelihood of other complications, including flap necrosis and carotid artery rupture, greatly increases.^[6,7,9,10] Early detection and management are thus essential in preventing potentially disastrous complications.

In our hospital, a radiographic swallowing study (RSS) is performed on or around the tenth postoperative day after total laryngectomy to evaluate the neopharynx and to exclude the presence of anastomotic complications before the nasogastric tube is removed and oral intake is resumed.

In clinical practice, the resumption of oral intake is often delayed based on clinically suspected fistula and/or abnormal findings reported by the radiologist during

Table 1 Population characteristics

Operation data	Tumor location			Total
	Hypopharynx ^a	Larynx	Other location ^b	
Total laryngectomy				
No pharyngectomy	0	3	–	3
Partial pharyngectomy	26	3	1	30
Total laryngectomy	11	–	1	12
Neck dissection				
No	2	1	1	4
Yes	35	5	1	41
Reconstruction				
Primary closure	14	4	1	19
PM flap	12	2	–	14
Free flap	11	–	1	12
Total	37	6	2	45

^aIncluded two patients with synchronous tumours.

^bOne patient had an oropharyngeal carcinoma with supraglottic extension. The other patient had a tracheal carcinoma extending into the oesophagus/hypopharynx.

swallowing studies in these patients. The purpose of this study was to evaluate the prognostic value of abnormal findings on RSS in the absence of clinical findings, on eventual wound healing.

Materials and methods

We retrospectively reviewed the medical records of 55 patients who underwent ablative surgery for primary malignancies of the larynx, hypopharynx and other tumour locations requiring a total laryngectomy followed by primary closure or a reconstruction. The patients had T3 or T4 tumours, which frequently necessitated partial pharyngectomy and flap closure. If a flap was not used, the pharynx was closed primarily in a T-shaped fashion. The patients had had no prior radiotherapy of the head and neck region. The study design was approved by the review board of our hospital.

Hard copies of the early postoperative radiographic swallowing studies performed in these patients were retrospectively reviewed. There were two indications for ordering studies:

- 1) A first RSS is performed on or around the tenth postoperative day to evaluate the neopharynx for possible leakage before starting oral alimentation.
- 2) Follow up radiographic swallowing studies are performed to assist in determining when to start feeding a patient in the process of recovery from a leakage or fistula.

Six patients were excluded because the radiographic swallowing studies were missing. Another patient was excluded because the neopharynx could not be evaluated due to stasis of contrast material making radiographic evaluation impossible. Three patients developed a clinical fistula before the first postoperative RSS was obtained. The early postoperative RSS was thus postponed. We excluded these patients because the complication

(fistula) was already diagnosed before the RSS was performed. The remaining 45 cases comprise our study group (Table 1). Among the 45 patients there were 38 male and 7 female patients. Their age at the time of laryngectomy ranged from 41 to 76 years, with a mean age of 56 years.

Forty-one patients had a neck dissection. Of these, 17 underwent primary closure of the remaining pharynx, 12 were reconstructed with a pedicled pectoralis major flap and 12 with a free flap. Four patients had no neck dissection. Of these, 1 patient underwent primary closure, 2 were reconstructed with a pectoralis major flap and one with a free flap.

The radiographic swallowing studies were performed using water-soluble contrast agent alone or water-soluble contrast agent followed by barium. A swallowing study consists of standard images made in the anteroposterior and lateral plane. If there were signs of leakage on the standard projections, additional views were made.

All radiographic swallowing studies were retrospectively reviewed by an experienced head and neck radiologist together with two plastic surgeons who were unaware of previous radiological reports or clinical data.

The radiographs were reviewed to evaluate the neopharynx and to determine if anastomotic complications were present. For classification purposes we developed a grading system based on the morphology of contrast medium extravasation (Fig. 1). Studies were graded by consensus reached by the reviewers for each patient. Some patients showed leakage at more than one site. In those cases, the highest grade was recorded. When we suspected communication of a contrast-filled tract with the skin of the neck we used the original report to verify if contrast leakage out of the tract was seen at that time.

The medical records were reviewed to determine whether a RSS was obtained as a routine test or whether the study was obtained because of clinical suspicion of a fistula. Signs and symptoms of impending fistula were defined as persistent fever, wound erythema, wound swelling, or persistent elevated neck-drain output.

We defined the interval between the initial abnormal RSS and the first repeat normal RSS as “resolution time”. The resolution time, the day of resumption of oral intake and the day of discharge of the patient from the hospital were all recorded. Radiologic findings and clinical outcome were evaluated and correlated.

All computations were carried out using SPSS 11.5 software. Fisher’s exact test was used to determine the significance of different variables. Statistical significance was defined as a two-tailed *p* value less than or equal to 0.05. Descriptive statistics were used to summarize study information.

Results

Of the 45 patients who underwent a routine postoperative RSS to rule out leakage before starting oral

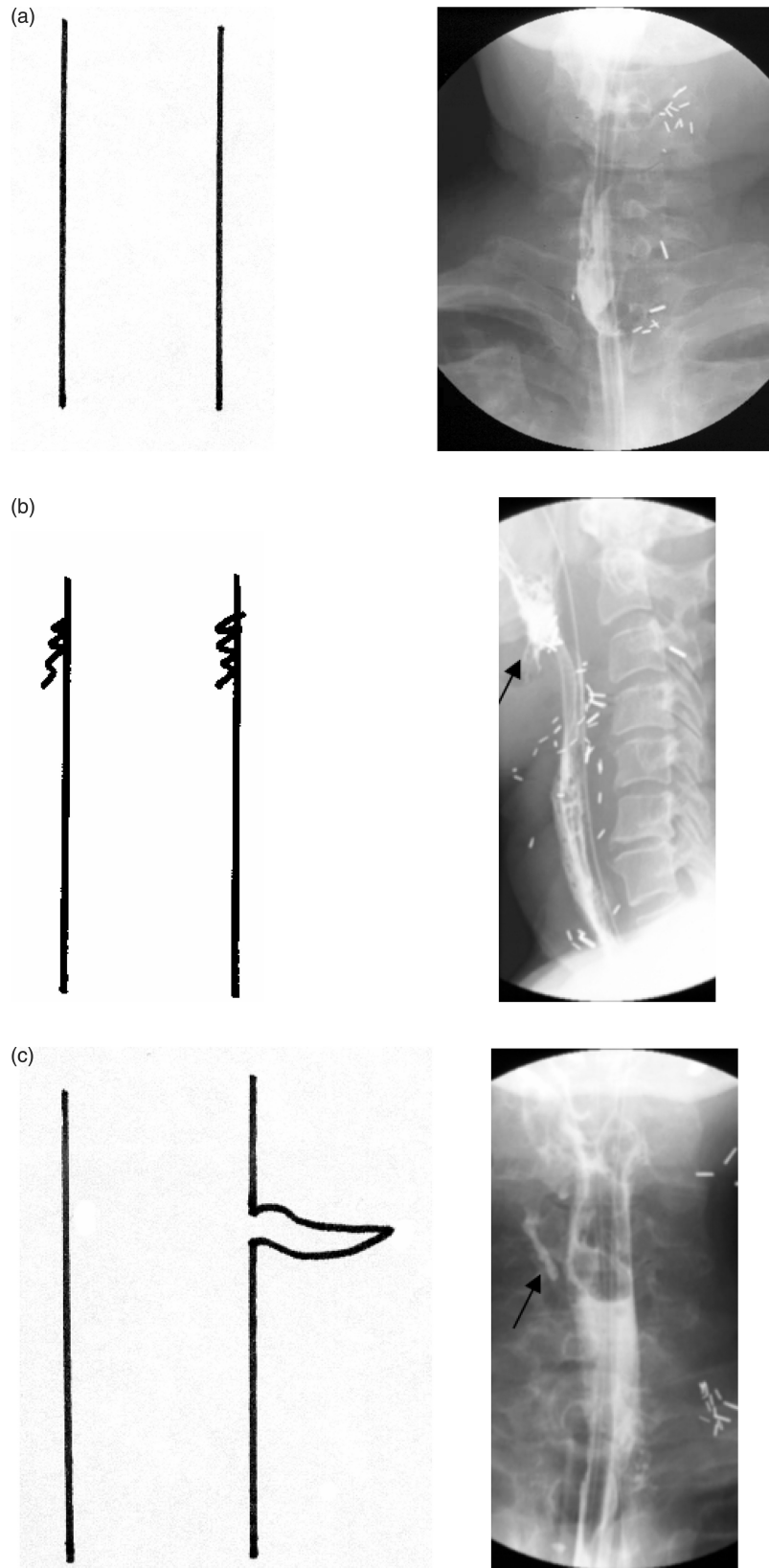


Figure 1 (a)–(f) Grading system for the classification of radiologic abnormalities after total laryngectomy. (a) Grade 0: normal. (b) Grade 1: irregular tissue based on mucosal redundancy at the proximal anastomosis (arrow). Note: This was considered a normal finding. (c) Grade 2: minimal extravasation (arrow) of contrast medium (blind-ending tract).

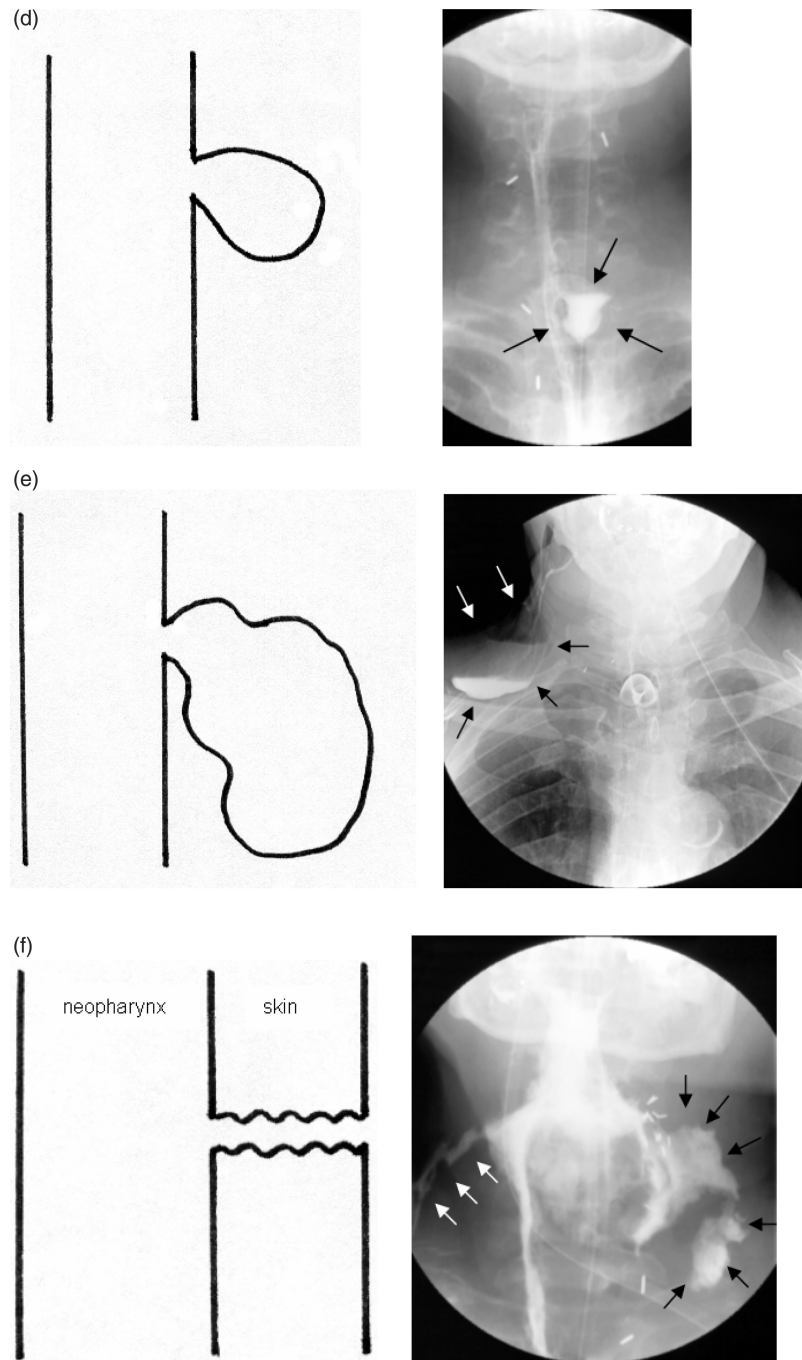


Figure 1 (continued) (d) Grade 3: moderate extravasation (arrows, moderate sealed-off collection). (e) Grade 4: large extravasation (arrows, large sealed-off collection). (f) Grade 5: pharyngocutaneous fistula (communication of a contrast-filled tract with the skin of the neck). There is a contrast-filled tract running from the neopharynx to the superficial soft tissues of the right neck (white arrows). The original report mentioned contrast leakage out of the tract onto the skin, proof of a true fistula. Note: This patient also had grade 4 extravasation in the left neck (black arrows).

alimentation, 22 patients had an abnormal RSS (Table 2). In this group, the following grades were recorded: 2 patients (9.1%) grade 1, 3 patients (13.6%) grade 2, 7 patients (31.8%) grade 3, 8 patients (36.4%) grade 4 and 2 patients (9.1%) grade 5. Three of the 22 patients (13.6%) had signs and symptoms of an impending fistula (see Fig. 2). The other 19 patients

with radiographically demonstrated leakages had no signs and symptoms of impending fistula and never developed clinical fistula. The clinical outcome in these patients was without complication. Fifteen of the 19 patients were not allowed to eat until a follow-up RSS showed no further evidence of continuing leakage.

Table 2 Results of first postoperative radiographic swallowing study (RSS) and clinical course

Grade	Clinical		Total	Resolution time (SE) in days ^a	Oral intake (SE) days postoperatively ^a	Hospital stay (SE) in days ^a
	Fistula	No fistula				
0	—	23	23	—	13 (1)	20 (1)
1	—	2	2	—	14 (3)	29 (8)
2	—	3	3	7 (0)	14 (2)	14 (1)
3	1	6	7	10 (2)	21 (3)	22 (3)
4	—	8	8	16 (2)	30 (3)	29 (4)
5	2	—	2	20 (1)	34 (1)	33 (7)
Total	3	42	45			

^aValues given are means. SE, standard error of the mean.

In four patients the original report was negative for leakage. However, in the review process the review panel considered these radiographs abnormal (grade 2–3). Retrospectively (using the grading system), the original reports of these four patients have to be considered as reading errors. These patients resumed oral intake, as (at the time) the radiological report was negative for leakage and they had no clinical symptoms of fistula. None of these four patients developed adverse consequences. Two of these patients underwent a total laryngopharyngectomy followed by a tubed free flap reconstruction. The other two patients underwent primary closure after a total laryngectomy and a total laryngectomy with a partial pharyngectomy, respectively.

In all patients, leakages and fistulae closed spontaneously. On average, the resolution time was 13 days (range 7–28 days). There was a significant association between the severity of leakage on the RSS and the resolution time of the radiological leakage ($p=0.010$), the day of resumption of oral intake ($p=0.000$) and the hospital stay ($p=0.015$) (Table 2).

Discussion

Debate about performing RSS post-operatively and about the exact interval to perform RSS is ongoing. To evaluate this controversy we retrospectively reviewed our experience to perform standard RSS 10 days post-laryngectomy. If this RSS is normal, oral feeding is started. In case of leakage, oral feeding is withheld and follow-up radiographic swallowing studies are performed at weekly intervals until there is no evidence of continuing leakage.

After total laryngectomy, radiographic swallowing studies may reveal anastomotic complications of varying severity. In the review process of the original radiographic reports, we frequently encountered inconsistent terminology. For example, the radiologist reported a 'fistula' but this was actually a contrast extravasation. Comparison between the radiological reports and the medical records also showed that radiologists and surgeons use different terms to describe the radiographic

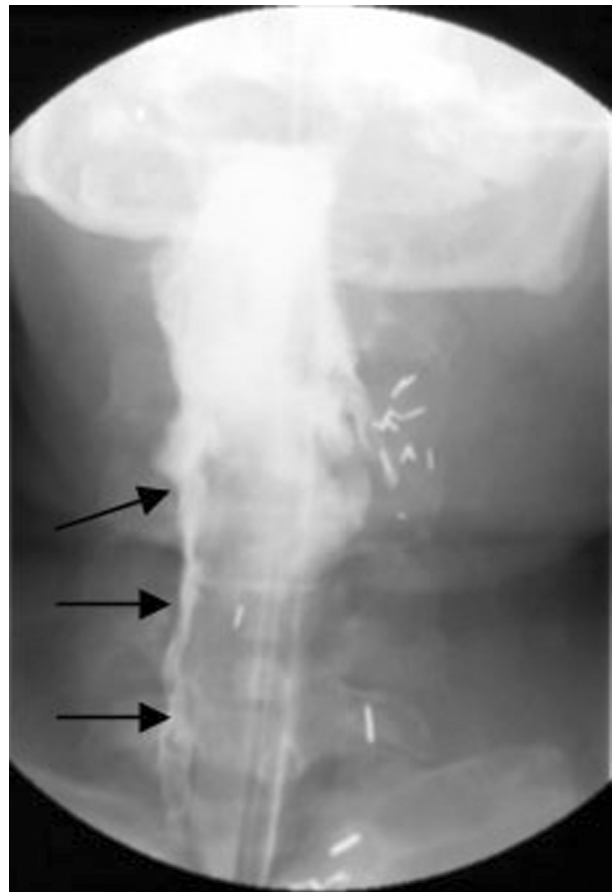


Figure 2 A 54-year-old man, with a right T4N0M0 piriform sinus carcinoma. A total pharyngolaryngectomy was performed. The hypopharyngeal defect was reconstructed using a tubed radial forearm flap. Nine days postoperatively a fistula was noted during patient care. Fourteen days postoperatively the first routine postoperative RSS was performed (grade 5, see Fig. 1f). Nasogastric tube feeding and local wound care were continued. The initial follow-up radiographic swallowing study 1 week later showing a persistent grade 2 extravasation on the right side. The grade 4 extravasation in the left neck has resolved. After 12 days a second follow-up RSS was performed. All the leakages have resolved (grade 0, see Fig. 1a). The resolution time was 19 days.

abnormalities. To avoid confusion it became clear that we needed a simple method to classify the various radiological abnormalities. Since the literature search did not yield such a method, we developed our own (Fig. 1). Use of such a grading system may ensure better communication between specialists.

There was a significant association between the severity of leakage (as expressed by the grading system) and resolution time of the radiological leakage, day of resumption of oral intake and hospital stay (Table 2). Use of our grading system may thus assist in predicting these variables. This could be confirmed in future (prospective) studies.

Most leakages were clinically silent and all resolved with conservative management, despite their severity. Even high-grade fistula healed spontaneously with local wound care, which is consistent with most previous reports^[1,4–6,8,11–13,16–18].

Not all clinical fistula could be radiographically demonstrated (1/3 cases were false negatives). We have to realise that there is continuous flow of saliva through the neopharynx and that clinical signs and symptoms are due to the cumulative effect of saliva in the fistula tract. However, the fistula tract can be relatively small, so it is not always likely to be filled (and demonstrated) during a standard RSS. In these cases, the clinical signs and symptoms prevail above the RSS findings. Cordeiro *et al.*^[13] concluded that in the case of clinical signs and symptoms of fistula, a radiographic contrast study does not give additional information and is unnecessary. This was the case in three of our patients, and we excluded them from this study.

All 23 patients who had no clinical signs or symptoms of impending fistula and no abnormal RSS, were fed the day of their RSS without the subsequent development of a fistula. This was also found in the study of Moses *et al.*^[9] and they concluded that there is no need to perform a RSS before starting oral alimentation in patients with no signs or symptoms of a fistula. However, in our study there were also 19 patients without clinical signs of a fistula but with an abnormal RSS. Oral intake was withheld in 15 patients. There were no adverse consequences in the four patients that started oral intake despite their abnormal RSS as found in the reviewing process (the original report was negative for leakage). As these four patient did well despite their abnormal RSS it might suggest that in the absence of clinical signs of fistula, limited radiographic leakage is not worrisome.

It is often difficult to decide when to resume oral intake after total laryngectomy. Common practice among head and neck surgeons is to withhold oral feeding for at least 7 days after total laryngectomy^[17], because it is generally believed that early feeding can increase the incidence of fistula formation. However, it is well known that even in the non-feeding state, saliva is constantly swallowed during the early postoperative period, and the pharynx is never really at rest after total laryngectomy^[12,17].

Boyce and Meyers^[17] considered that the time of oral feeding has little to do with the development of fistula and the motion of the nasogastric tube is probably more irritating than oral feeding three times a day. Moses *et al.*^[9] and Akyol *et al.*^[16] also believe that oral feeding does not cause significant additional stress to the suture line. After laryngectomy the pharynx becomes less dynamic and more of a conduit with lower pharyngeal and lower oesophageal sphincter pressure^[17]. The four patients mentioned above that started early oral feeding despite their abnormal RSS could support these findings.

In the study of Seven *et al.*^[12] patients post total laryngectomy and primary closure were fed on the first postoperative day without adverse consequences. The fistula rate was 6.2% compared to 9% of the patients who were fed through tracheoesophageal puncture and received nothing orally until the seventh postoperative day. (Tracheoesophageal puncture (TEP): a small opening made in the wall that separates the oesophagus and trachea. A one-way valve keeps food out of the trachea but permits inflow of air for oesophageal speech. A tube can be inserted through the TEP to feed the patient.) It remains a question if the same conclusion can be drawn in patients with an additional reconstruction after ablative surgery. In these patients, there are two or three separate suture lines that may leak or become contaminated by oropharyngeal contents.

Some of our results support the findings of Seven *et al.*^[12]. We found radiographic leakage, but without clinical sequelae. However, it may also be possible that delaying the oral intake (based on abnormal RSS findings) may be the reason why no clinical signs appeared (because the radiological leakage has time to heal and does not progress into a fistula). Only prospective studies, randomizing post-laryngectomy patients in two groups (with and without RSS) can solve this issue.

In case of clinical fistula a RSS can give additional information, which can lead to the decision to withhold oral intake.

In our study some radiographic swallowing studies were performed using water-soluble contrast agent alone and others were performed using a water-soluble contrast agent followed by barium. Barium has a greater radiopacity, resulting in a higher sensitivity in the detection of leaks^[3,19,20]. In our retrospective setting we could not correct for this factor, because not all the radiographic reports mentioned the contrast agent used. Swanson *et al.*^[19] and Tanomkiat *et al.*^[20] conclude that a barium swallow should follow a negative study using an aqueous agent in clinically suspected postoperative leakage. They consider the use of barium as a safe initial study in postoperative patients when a leak is not suspected on clinical grounds. Krouse *et al.*^[7,18] concluded that barium swallow may only be considered for patients who are at high risk for fistula formation (patients with postoperative complications or a history of preoperative radiation).

Conclusions

After total laryngectomy radiographic swallowing studies may reveal anastomotic leakage of varying severity. The grading system used in this study enabled us to objectively classify the radiological abnormalities on swallowing studies. There was a significant association between radiographic leakage grade and the resolution time, the day of resumption of oral intake and the hospital stay. Most radiographic leakages are clinically silent. Not all

clinically apparent fistula were radiographically visible. The prognostic value of abnormal findings on radiographic swallowing studies after laryngectomy, in the absence of clinical signs of fistula, remains unclear. Prospective studies, randomizing post-laryngectomy patients in two groups (with and without RSS) can solve this issue.

Acknowledgements

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