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Original article

Value of intraoperative ultrasonography in tonsil cancer[☆]

Jakub Pazdrowski^{a,*}, Pieńkowski Piotr^a, Magdalena Kordylewska^a, Anna Wegner^a,
Paweł Golusiński^a, Wojciech Golusiński^{a,b}

^a Department of Head and Neck Surgery and Laryngological Oncology, Greater Poland Cancer Centre, Poland

^b Poznań University of Medical Sciences, Poland

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ABSTRACT

Background: The exact assessment of a tonsil carcinoma's size is often difficult because of the tumour's submucosal extension and deep infiltration.

Aim: The aim of the study is to assess the usefulness of intraoperative ultrasonography in tonsil cancer.

Material: Twenty patients with carcinoma of the tonsil were included in the study (squamous cell carcinoma keratosis – 12, squamous cell carcinoma akeratosis – 6, diffuse large B cell lymphoma – 1, neoplasma malignum microcellulare – 1).

Method: Transcutaneous, endoscopic, and intraoperative ultrasonography were performed using a linear 7.5 MHz probe.

Results: The difference in the results was statistically significant between palpation examination and intraoperative ultrasonographic examination, between transcutaneous ultrasonographic examination and intraoperative ultrasonographic examination, and between endoscopic ultrasonographic examination and intraoperative ultrasonographic examination in tonsil tumours. Generally, tumour size assessed by intraoperative ultrasonography was more advanced than those assessed by other methods.

Conclusions: Intraoperative ultrasonography is a safe, non-invasive method, which can be repeated at every stage of surgery. There were no contraindications or side effects. In all cases histological margins corresponded to sonographic margins. Intraoperative ultrasonography provides a quick and reliable orientation during resection of tonsil carcinoma.

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1. Background

In Poland, the most frequent location of the cancerous process is the respiratory system. In the material of the Otolaryngological Clinic in Poznań covering 1980–1999 tonsil cancer accounted for 34.8% of all oral cavity cancers and orophar-

ynx cancers.¹ The peak incidence of oral cavity cancers and oropharynx cancers falls in the fifth, sixth and seventh decades of life in men (the sixth being most common) and a little later in women. At the same time men suffer from these cancers – according to various authors – from 2 to 4 times more often than women.² Oral cavity cancers and oropharynx cancers belong to the group of tobacco-related cancers.¹

[☆] Przydatność śródoperacyjnego badania ultrasonograficznego w nowotworach migdałka podniebiennego.

* Corresponding author. Tel.: +48 618850928; fax: +48 618850910.

E-mail address: jakub.pazdrowski@op.pl (J. Pazdrowski).

The second fundamental and independent aetiological factor is alcohol abuse, with exposure to both factors causing a multiplicative increase in the risk of cancer development.¹ Human papilloma viruses (HPV) – most often HPV 16 and HPV 18 – and also Epstein-Barr (EBV) virus are among the most important carcinogenic factors.

Oral cavity cancer and oropharynx cancer are characterized by rapid growth and clinical malignancy. The lesions remain painless for a long time, and in consequence patients go to see doctors late with very advanced cancers. The “silent” nature of the carcinoma means that its first noticed symptom may be enlarged neck lymph nodes.¹ In tonsil cancer early symptoms are a sensation of itching and burning throat, and obstructed airway. With progression of the lesions the symptoms become similar to those of tongue cancer, dominated by pain while swallowing, otalgia and increasing trismus.¹ Asymmetry of the tonsils is notable. Frequently observed are exophytic hard masses or ulcers extending deep into the tonsil and its capsule.¹

Spread of cancer by metastases involves mainly the lymphatic system of the neck. The metastases usually affect neck lymph nodes of levels I, II, and III. Depending on the stage of progression, in 30–60% of patients lymph node metastases are observed at the moment of diagnosis/visiting a doctor.¹

The scheme of treatment of oral cavity cancer and oropharynx cancer comprises surgical treatment and radiotherapy. In the case of early-stage cancers (T1, T2) radiotherapy³ or surgery⁴ is recommended. In patients with more advanced cancer, the use of the classical method of surgical treatment supplemented with post-operative radiotherapy^{4,5} seems to be advisable.

Tonsil tumours are still a diagnostic challenge. Submucosal extension of a tumour and palmate projections infiltrating healthy tissues frequently prevent a correct assessment of the extent of the process in the palpation examination. Helbig et al. state that agreement of the assessment of tumour extent in palpation and histopathological examination is only 40%.⁹ On one hand, as they state, the size of the tumour in the palpation examination was usually larger than its real size in the histopathological examination, which led to an increase of the resection area and as a result may have caused complications such as major articulation or swallowing disorders. On the other hand, it was difficult to assess the extent of infiltration in the case of small tumours through the palpation examination, which could have led in extreme cases to non-radical removal of the lesion. Therefore, in order to correctly assess the tumour extent various imaging methods are used. Because of the great accessibility and low costs of the examination, the most common method of imaging head and neck tumours is currently ultrasonography.¹⁰ A method enabling placement of the probe directly on the organ we want to image is intraoperative ultrasonography.

2. Aim

The aim of the study is to assess the usefulness of intraoperative ultrasonography in tonsil cancer.

3. Material

Twenty patients diagnosed on the basis of clinical imaging and histopathological examination with tonsil cancer were included in the study (Table 1). These patients were surgically treated in the Department of Head and Neck Surgery and Laryngological Oncology of the Greater Poland Cancer Centre during the period 2007–2009.

Apart from the interview and physical examination, transcutaneous and endoscopic ultrasonography were routinely performed in every patient.

In each case the clinical diagnosis was confirmed with a histopathological biopsy assessed in the Pathology Department of the Greater Poland Cancer Centre. Then the patient underwent surgery during which ultrasonography was performed. Tissue removed during the surgery was sent for histopathological assessment to verify the diagnosis and assess cleanness of margins.

4. Method

The ultrasonographic examination was performed at each stage with Aloka SSD 500 apparatus using a 7.5 MHz linear probe with 39 mm transducer surface.

During each ultrasonographic examination the following parameters were assessed: location and extent of infiltration; echogenicity (decreased, increased); echo structure (homogeneous, heterogeneous); contour (smooth, polycyclic, blurred); infiltration of neighbouring anatomical structures; presence of satellite foci.

Additionally, in the intraoperative ultrasonography margins of lesions were assessed and tissue echogenicity after completion of tumour resection was evaluated.

5. Results

A total number of 20 patients were assessed by palpation and intraoperative ultrasonography. With the palpation technique, four patients were assessed as tumour size T1, 10 as T2, three as T3, and three as T4. By intraoperative USG two patients were assessed as T1, eight as T2, four as T3, and six as T4. Generally tumour sizes assessed by intraoperative USG were more advanced than those assessed by palpation (Table 2).

A total number of 15 patients were assessed by transcutaneous USG and intraoperative USG. With the transcutaneous

Table 1 – Material.

| Women | | | Men | | | Total | | |
|-----------|-------------|-----------------|------------|-------------|-----------------|-------|-------------|-----------------|
| n (%) | Average age | Age group range | n (%) | Average age | Age group range | n (%) | Average age | Age group range |
| 5 (23.8%) | 55.6 | 51–68 | 15 (76.2%) | 54.0 | 12–81 | 20 | 54.8 | 12–81 |

Table 2 – Agreement of results of palpation examination vs. intraoperative ultrasonography.

| | Palpation examination | Intraoperative USG |
|-------|-----------------------|--------------------|
| T1 | 4 | 2 |
| T2 | 10 | 8 |
| T3 | 3 | 4 |
| T4 | 3 | 6 |
| Total | 20 | 20 |

Table 3 – Agreement of results of transcutaneous vs. intraoperative ultrasonography.

| | Transcutaneous USG | Intraoperative USG |
|-------|--------------------|--------------------|
| T1 | 6 | 1 |
| T2 | 7 | 7 |
| T3 | 1 | 2 |
| T4 | 1 | 5 |
| Total | 15 | 15 |

USG, six patients were assessed as T1, seven as T2, one as T3, and one as T4. With the intraoperative USG, one patient was assessed as T1, seven as T2, 2 as T3, and five as T4. Generally, tumour sizes assessed by intraoperative USG were more advanced than those assessed by transcutaneous USG (Table 3).

In five cases the tumour mass was not revealed in the transcutaneous examination. In these cases, one patient was assessed as T1, one as T2, 2 as T3, and one as T4 in the intraoperative examination.

A total number of 18 patients were assessed by endoscopic USG and intraoperative USG. With the endoscopic USG two patients were assessed as T1, 12 as T2, 3 as T3, and one as T4. With the intraoperative USG one patient was assessed as T1, eight as T2, four as T3, and five as T4. Generally, tumour sizes assessed by intraoperative USG were more advanced than those assessed by endoscopic USG (Table 4).

In two cases endoscopic ultrasonography was not performed. The reasons for not performing the examination were:

- in one case trismus occurred;
- in one case bleeding of the ulcer occurred upon touching.

Also:

- In two patients a radical surgery could not be performed due to the infiltration penetrating towards the laryngopharynx.
- Extension of the surgery based on ultrasonographic image was performed in five cases.
- Positive margin in intraoperative ultrasonographic assessment was histopathologically confirmed in four cases (80%).

Table 4 – Agreement of results of endoscopic ultrasonography vs. intraoperative ultrasonography.

| | Endoscopic USG | Intraoperative USG |
|-------|----------------|--------------------|
| T1 | 2 | 1 |
| T2 | 12 | 8 |
| T3 | 3 | 4 |
| T4 | 1 | 5 |
| Total | 18 | 18 |

- Local recurrence was observed in two patients: after 1 month and after 6 months. Nodular recurrences were not observed in these patients. Local recurrences were not observed in the patients for whom the surgery was extended during removal of the primary foci.
- Nodular recurrence was observed in three cases: after 1 month, after 7 months, and after 18 months, in each case on the opposite side of the primary location of the tumour. Features of local recurrence were not observed in these patients. In one of these patients the surgery was extended during the operation on the primary focus (the patient with recurrence after 18 months).
- Distant metastases were not observed among patients.
- In two patients a second primary cancer was found: in one patient the cancer was located within the ethmoid sinus, nasal cavity, and orbit; in the other cancer expansion within the larynx was found.

The following were found through histopathological examination:

- squamous cell carcinoma keratosis: 12
 - squamous cell carcinoma akeratosis: 6
 - diffuse large B cell lymphoma: 1
 - neoplasma malignum microcellulare: 1
- 20

The patients in whom a non-radical surgery was performed, apart from the surgery aimed at decreasing the tumour mass, were treated palliatively. The other patients, apart from the surgery, underwent radiotherapy within a period of up to 6 weeks after surgery.

The cancer staging assessed by the palpation examination, transcutaneous ultrasonography, endoscopic ultrasonography and intraoperative ultrasonography was assessed statistically. The difference in the results was statistically significant between palpation examination and intraoperative ultrasonographic examination, between transcutaneous ultrasonographic examination and intraoperative ultrasonographic examination, and between endoscopic ultrasonographic examination and intraoperative ultrasonographic examination in tonsil tumours, which was confirmed in the statistical analysis using the Wilcoxon matched pairs test ($p < 0.01$).

The intraoperative ultrasonographic examination enabled images free of artefacts to be obtained for all patients subjected to the examination. The intraoperative probe was mobile in all directions, which enabled thorough visualisation of the tumour mass and assessment of its size in all three dimensions. Sonographic identification of the tumour borders allowed the lesion to be removed while retaining a safety margin. The performance of the surgery was additionally facilitated by revealing neighbouring anatomical structures. The examination was performed several times during the surgery (from 3 to 6 times), according to the surgeon's needs. Complications resulting from the use of this method were not observed in any of the patients.

6. Discussion

For many years, ultrasonography has been the basis for diagnosis in many areas of medicine. Fundamental advantages

of this method are its non-invasiveness, repeatability, easy access for examination, and the lack of complications.^{6,10} It is often the first imaging method used immediately after a clinical examination.^{6,10} Ultrasonographic examination has an unassailable position in laryngology for assessing tumours of the neck and lymphatic nodes of the head and neck regions.^{6,10} The endoscopic method used in laryngology to assess tumours of the oral cavity and oropharynx is a modification of the classical ultrasonographic examination.¹⁰

In this study an attempt was made to assess the usefulness of intraoperative ultrasonography for imaging of tonsil tumours.

Significant statistical differences were observed concerning cancer staging between palpation examination and intraoperative ultrasonographic examination, transcutaneous ultrasonographic examination and intraoperative ultrasonographic examination, and endoscopic ultrasonographic examination and intraoperative ultrasonographic examination in tonsil cancer. The greatest statistically significant difference was found in the comparison between transcutaneous ultrasonographic examination and intraoperative ultrasonographic examination. The cancer staging assessed through intraoperative ultrasonography was equal to or greater than the staging obtained in other examinations.

It should be emphasized that in as many as five cases the tumour mass was not revealed in the transcutaneous ultrasonographic examination. This means that only in 71% of cases the ultrasonographic images obtained suggested the presence of a cancerous lesion. An important element hindering assessment through transcutaneous ultrasonography is the presence of a layer of skin and subcutaneous tissue. Placing the probe directly on the examined organ, as is the case with the endoscopic and intraoperative ultrasonographic examination, permits deeper penetration by the ultrasonic wave. As a result, despite objectively identical parameters of examination, and identical resolution and size of the probe, endoscopic or intraoperative examination provides a closer image with significantly finer distinction of details.⁷ These features also influence the assessment of the cancer staging, and in the transcutaneous ultrasonographic examination the observed infiltration usually qualifies as a tumour of lower staging compared with endoscopic or intraoperative examination.

Although, from the technical point of view, the endoscopic examination is very similar to the intraoperative examination, it is also marked with substantial limitations of an anatomical-physiological nature. In the presented material in as many as two cases, i.e. in 14%, endoscopic examination could not be performed: in one patient trismus occurred, and in one cratered ulcer bleeding was observed upon touching. Other authors have also encountered similar difficulties. Apart from trismus and ulcer bleeding upon touching, they also described excessive vomiting reflexes that did not abate after administering medication.⁷

It was found in this study that intraoperative ultrasonographic examination allows to obtain images free of artefacts providing accurate visualisation of the tumour mass with the possibility to assess it in all three dimensions. The next stage was a resection of the lesion, where sonographic identifica-

tion of the tumour borders permitted removal of the lesion while retaining a margin of healthy tissues. It is emphasized in numerous publications that this technique critically influences the planning of surgery, and makes it easier and safer, including through visualisation of neighbouring anatomical structures such as vessels.⁸ As they emphasized, this is an invaluable tool when surgery is performed by a less experienced surgeon.⁸ It is also worth noting that the procedure can be repeated at every stage of a surgery, according to the surgeon's expectations. In the present study the procedure was repeated 3–6 times within one operation. Apart from the undeniable advantages, intraoperative ultrasonography also has certain limitations resulting mainly from the size of the probe, which prevents accurate assessment of penetration of the infiltration towards the nasopharynx and the laryngopharynx. However, this limitation was not significant for the described study.

7. Conclusion

In conclusion, it should be emphasized that the advantages of ultrasonography make it a very good intraoperative tool. The procedure is safe, does not unduly strain either the patient or the staff, and does not require any special preparation of the patient. It can be repeated at every stage of a surgery. It is also worth noting that currently there are no contraindications for using the described procedure and no complications resulting from its application have been observed.

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