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*Imaging diagnostics strategy in maxillary sinus neoplasms*

Malignant neoplasms of maxillary sinuses are a considerable problem because they grow for a longer time without any clinical signs. On the other hand, the appearing symptoms are often misleading thus the beginning of treatment is late (13). Surgical treatment is frequently very mutilating and complementary chemo- or radiotherapy are not always efficient. Hence the goal of the clinician suspecting a maxillary sinus neoplasm is planning of such a strategy of imaging diagnostics methods that would lead as soon as possible to the diagnosis of the pathological process and the onset of treatment, which is crucial in cases of malignant neoplasms. On the other hand, in the times of changes in financing of the health services the economical side of diagnostics must be more and more often taken into account. This problem has been defined in the English literature as cost-effectiveness, that is the relationships between diagnostic benefits and the costs of a given imaging diagnostics method. So at present in all the fields of medicine there are tendencies to determine diagnostic algorithms in individual disease entities. Due to the importance of the problem the aim of the present paper was the elaboration of imaging strategies in diagnostics of maxillary neoplasms.

MATERIAL AND METHODS

The material presented the analysis of 163 case records of 78 patients with maxillofacial neoplasms examined in the years 1995-2001 in the Department of Dental and Maxillofacial Radiology and the 2nd Department of Medical Radiology of the Medical University of Lublin. For the analysis there were chosen the results of imaging examinations of patients with clinically confirmed malignant neoplasm of the maxillary sinus. In each case the initial and final diagnoses were recorded as well as the number and succession of taken X-rays as well as performed computed tomography (CT) examinations and ultrasound examinations of the affected region. Unfortunately in the studied material there were no patients who underwent magnetic resonance imaging (MRI) examination of the maxillofacial region due to low accessibility of the equipment in the Lublin region. All maxillofacial X-rays were taken using conventional radiography methods, including the Louisette's view projection applied in the Department of Dental and Maxillo-facial Radiology. All CT examinations were performed using the Siemens Somatom AR-T (Erlangen, Germany) equipment in coronal and/or axial scans of 2 or 3 mm thickness. All the examinations had two phases: without contrast enhancement and after intravenous injection of contrast medium in the dose of 1 ml/kg. The obtained scans were supplemented by secondary multiplanar reconstructions (MPR), mainly sagittal ones but also reconstructions along

an irregular line. In cases when bone destruction was evident in the bone window, also pseudo-3D reconstructions were obtained at the level of +150–+250 H.U. in order to provide a spatial visualization of the defect in maxillofacial skeleton.

## RESULTS

In cases of neoplasms of the maxillary sinus most often there were taken Waters' view projections of the paranasal sinuses. Next, the diagnostics was supplemented by lateral X-ray of the maxillofacial skeleton followed by PA projection of this region. In the Department of Dental and Maxillofacial Radiology of the Medical University of Lublin there are also taken Louissette view X-rays. Panoramic pictures taken in the analyzed patients should be considered routine radiograms taken in new patients as survey X-rays. However, it was also possible to evaluate the bone destruction on such pictures, especially in the postero-lateral wall and floor of the maxillary sinus as well as of the alveolar bone. The shortcomings of panoramic X-rays are numerous: the presence of shadows of soft tissues, the appearance of artifacts as well as the character of the X-ray itself – that is the visualization of only the focal plane. Due to the choice of the material for the present study, all the included patients underwent at least one CT examination. The CT examination of the maxillofacial region allowed for imaging of pathological masses, bone destruction as well as the detection of the presence of regional lymph nodes (Fig. 1). Pseudo-3D CT reconstructions enabled spatial evaluation of bone destruction and initial planning of surgery (Fig. 2). The number of the performed diagnostic imaging examinations is presented in the form of a chart (Fig. 3), while the proposed strategy of application of imaging methods as a scheme (Fig. 4).



Fig. 1. Coronal CT scan in a patient with neoplasm of the left maxillary sinus infiltrating the nasal cavity and right maxillary sinus



Fig. 2. Pseudo-3D CT reconstruction in the same patient well presents spatial

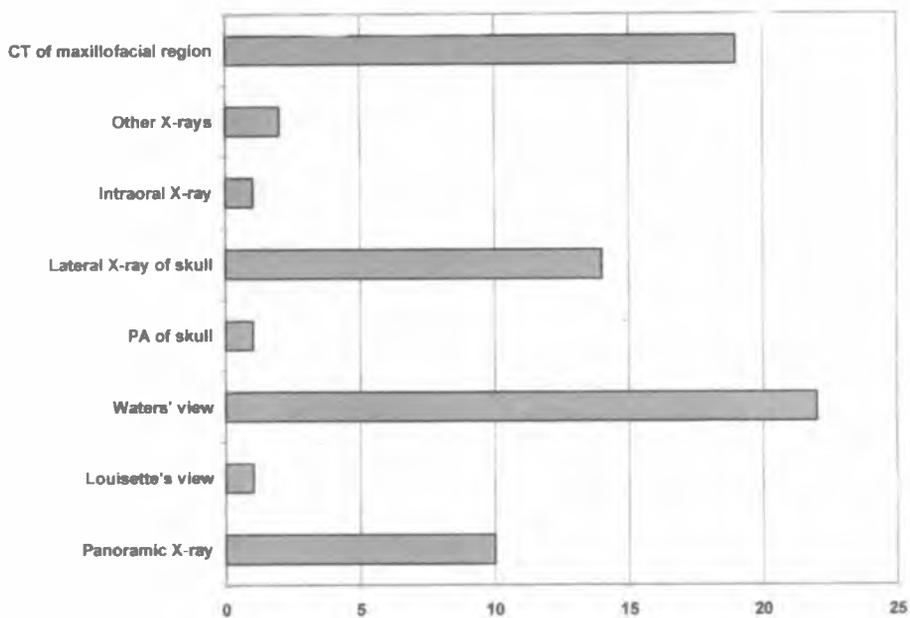


Fig. 3. Imaging diagnostics examinations taken in patients with maxillary sinus neoplasms

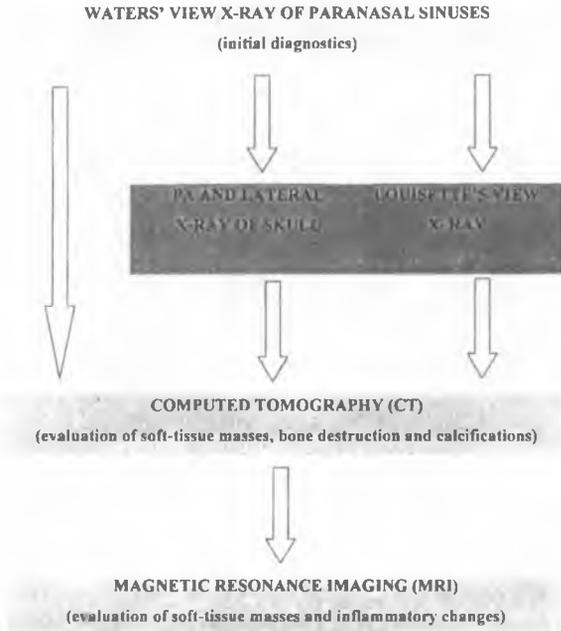


Fig. 4. Algorithm of application of imaging diagnostics techniques in maxillary sinus neoplasms

## DISCUSSION

About 80-90% of neoplasms of the paranasal sinuses are carcinomas, mainly spinocellular or undifferentiated (13). They are characterized by infiltration and destruction of bone tissue. According to S o m et al. (11) maxillary neoplasms can also arise from olfactory nerves (esthesioneuroblastoma). Lymphomas or sarcomas (13) of the paranasal sinuses are less often encountered (13). Maxillary sinus neoplasms do not manifest themselves for a long period and are often detected in the advanced stage, which was confirmed by own observations (Fig. 1). One of the greatest challenges in maxillofacial radiology is precise demarcation of the extent of tumour. Such piece of information influences the choice of treatment (9).

Among the methods of imaging of maxillary sinus are the Waters' view X-rays (5) as well as the lateral and PA X-rays of the maxillofacial region (14) that was confirmed by the material analyzed in the present paper (8). It is still believed that conventional X-rays are valuable especially in the survey of maxillary sinuses (1). According to many authors radiograms of sinuses give information necessary in planning of the subsequent examinations such as CT and MRI (1).

CT examination with contrast enhancement allows in cases of maxillofacial tumours detection of the diagnosis as well as the evaluation of local extent of neoplasm (4, 6). According to some authors (2) MRI is more accurate than CT in delineation of tumour margins as well as of infiltration of soft tissues, without necessity of intravenous injection of contrast medium. However, CT is superior to MRI in showing the details of bone structure, as compact bone produces no signal in MR tomography technique (Fig. 1 and 2). Similarly, CT shows calcifications in pathological masses that are not evident in MR examination. CT is also significantly better than MRI in the maxillofacial region where there

are many thin bone plates, as it is in neoplasms originating in paranasal sinuses, nasal cavity, nasopharynx and parapharyngeal space (3). According to other authors (7) CT and MRI are equivalent in evaluation of malignant neoplasms of the maxillofacial region. However, it must be taken into account that artifacts caused by amalgam dental fillings and dental prosthetic appliances are much more distinct in CT images (7). As stated by S o m et al. (9) in almost half of the studied cases, CT and MRI were comparable in defining the tumour margins. Often MRI was more effective as CT presented with more details only tumours infiltrating bone tissue or arising from it.

Malignant lesions are more homogenous in MR image. They are characterized by low and medium signal intensity both in T1- and T2-weighted images. Within tumours there can appear low and medium intensity areas in T1-weighted images, which are hyperintense in T2-weighted images and correspond to necrotic tissues containing considerable quantities of fluids. Medium and high intensity areas in T1- and T2-weighted images characterize focal hemorrhages (12). Well-vascularized tumours such as angiofibroma also give low and medium signal in T1-, T2-weighted and proton density images, while in their stroma there are visible highly vascularized areas (9).

Neoplasms originating in small salivary glands of the maxillary mucosa contain mucous or serosal fluid which due to high content of water is very hyperintense in T2-weighted images. In tumours composed mostly of cellular part with only slight content of mucus the MRI signal is heterogeneous, of medium intensity (9).

Differentiation between neoplastic masses and accompanying inflammatory changes in sinuses and nasal cavity is often difficult. The CT examination with contrast enhancement allows for measurements of pathologic mass density and frequently for differentiation between mucous and inflamed mucosa and neoplastic masses (9). Inflammatory tissues and neoplasms vary in signal intensity in T2-weighted images. This enables good identification of margins of tumour lying in vicinity of inflammatory changes (10). Diagnostic difficulties appear when the lesions contain bone elements with areas of marrow, hemorrhages or degenerative changes. Such lesions are well visualized in CT (13).

It is essential to differentiate recurrence of neoplasm from active inflammatory process that develops during chemo- or radiotherapy. The differentiation between recurrent tumour and granulomatous tissue after surgery is more challenging. Directly after surgery dominates active inflammatory process that produces high signal in MRI, but the appearing with time fibrous tissue has a lower and lower signal that causes general medium signal intensity in T2-weighted images. Thus it is impossible to make a distinction between this and early recurrence (10).

Most of the advanced neoplasms originating in sinuses infiltrate the bones of the base of the anterior cranial fossa: the medial part of the superior wall of the orbit, the posterior wall of the maxillary sinus as well as crista galli. Also benign processes, such as chronic polyposis, can traverse the walls of the anterior cranial fossa. It is possible to verify the benign or malignant character of the process on the basis of MRI (11).

## CONCLUSIONS

1. Conventional X-ray pictures are applied in diagnostics of neoplasms of maxillary sinuses especially as survey radiograms, indicating further course of diagnostic imaging.
2. Computed tomography examination with contrast enhancement enables the diagnosis and delineation of local extent in cases of neoplasms of maxillary sinuses.

3. MR imaging better presents tumour margins and soft-tissue infiltration in comparison with CT.

4. The superiority of CT over MR is evident in imaging of details of bone structure as well as of pathological calcifications.

5. The differentiation between recurrent neoplasm and inflammatory changes appearing in the course of chemo- or radiotherapy is still a diagnostic problem.

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## SUMMARY

Malignant neoplasms of maxillary sinuses are a serious diagnostic and therapeutic challenge, so the objective of a clinician is the planning of a cost-effective strategy promptly leading to proper diagnosis and the onset of treatment. Thus the aim of the paper was the elaboration of diagnostic strategy in maxillary neoplasms. There were analyzed 163 case records of 78 patients with maxillofacial neoplasms. The number and sequence of the conventional radiograms as well as diagnostic imaging methods were registered. There was proposed an algorithm of application of imaging techniques in diagnostics of neoplasms of maxillary antra. It was found that conventional X-rays are still valuable in screening for sinus pathology and as indication of the necessity of performing other imaging examinations. Computed tomography and magnetic resonance are complementary in visualization of pathologic masses and bone tissue destruction.

## Strategia badań obrazowych w nowotworach zatoki szczękowej

Nowotwory złośliwe zatok szczękowych stanowią poważny problem diagnostyczny i leczniczy, dlatego zadaniem klinicysty jest takie zaplanowanie strategii badań obrazowych, aby jak najszybciej doprowadziła ona do rozpoznania procesu chorobowego i rozpoczęcia leczenia, przy jednoczesnej dbałości o ekonomiczny aspekt diagnostyki obrazowej. Celem pracy było zatem opracowanie strategii badań obrazowych w diagnostyce nowotworów zatok szczękowych. Przeanalizowano 163 historie choroby 78 pacjentów z nowotworami części twarzowej czaszki pod kątem liczby i kolejności wykonanych klasycznych radiogramów oraz innych badań obrazowych. Zaproponowano schemat zastosowania technik obrazowania w diagnostyce nowotworów zatok szczękowych. Stwierdzono, że konwencjonalne zdjęcia rentgenowskie znajdują zastosowanie w diagnostyce zmian nowotworowych zatok szczękowych jako zdjęcia przeglądowe, pozwalające na wskazanie konieczności zlecenia kolejnych badań obrazowych. Tomografia komputerowa i rezonans magnetyczny są metodami wzajemnie uzupełniającymi się w zakresie obrazowania mas patologicznych i destrukcji tkanki kostnej.

