CASE REPORT

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Squamous cell carcinoma of the scalp with intracranial extension – the importance of various imaging modalities

Planocelularni karcinom poglavine sa intrakranijalnim širenjem – značaj različitih modaliteta snimanja

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Abstract

Introduction. Around 2% of all cutaneous neoplasms arise in the scalp and can be classified as either primary or metastatic. The intracranial extension is rare in cutaneous malignancies but can generally occur if left untreated. Squamous cell carcinoma (SCC) is the second most common type of nonmelanoma skin cancer after basal cell carcinoma. About 3–8% of SCCs are located on the scalp and can cause skull and dural invasion in rare cases. **Case report.** A 49-year-old male patient presented with a large and painful lesion in the parietooccipital region of the head. Magnetic resonance imaging (MRI) revealed a large inhomogeneous, necrotic lesion with infiltration of the underlying skull and dura. The patient underwent surgical removal of the tumor with excision of invaded skin, bone, and dura with a safety margin of 1 cm, followed by custom prefabricated 3D-printed cranioplasty with polymethylmetacrilate. Pathohistological analysis revealed invasive SCC with immunohistochemistry staining revealing CK5/6 and CK7 positivity. **Conclusion.** Some cases of scalp SCCs can cause invasion of the underlying skull and dura if left untreated. Imaging modalities like computed tomography (CT) and MRI play a crucial role in evaluating the degree of neoplastic extension and potential calvarial and dural invasion, thus being of significant importance in preoperative planning and management.

Key words:
diagnosis; histological techniques; immunohistochemistry; magnetic resonance imaging; neoplasm invasiveness; neoplasms, squamous cell; neurosurgical procedures; scalp.

Apstrakt

Uvod. Oko 2% svih neoplazmi kože javlja se na poglavini, i mogu biti klasifikovane kao primarne i metastatske. Intrakranijalno širenje je retko kod maligniteta kože, ali se generalno može javiti kada se lečenje odlaže. Planocelularni karcinom (PCK) je drugi najčešći tip nemelanomskog karcinoma kože posle bazocelularnog karcinoma. Oko 3–8% PCK lokalizovano je na poglavini, i u retkim slučajevima mogu se širiti intrakranijalno i infiltrisati tvrdu moždanu opnu (duru). **Prikaz bolesnika.** Bolesnik star 49 godina javio se na pregled sa velikom, bolnom tumefakcijom na levoj parijetookcipitalnoj regiji glave. Na snimku dobijenom magnetnom rezonancom (MR) uočene su velike, nehomogene, nekrotične lezije, sa infiltracijom podležuće lobanje i dure. Bolesniku je tumor hirurški odstranjen ekscizijom infiltrisane kože, lobanje i dure sa bezbednosnom marginom od 1 cm, posle čega je urađena kranioplastika korišćenjem prethodno specifično konstruisanog 3D grafta od polimetilmetakrilata. Patohistološkom analizom utvrđen je invazivni PCK, a imunohistohemijskom analizom je nađena CK5/6 i CK7 pozitivnost. **Zaključak.** U nekim slučajevima, kada se lečenje odlaže, PCK poglavine može izazvati invaziju podležuće lobanje i dure. Modaliteti snimanja kao što su kompjuterizovana tomografija i MR igraju važnu ulogu u proceni širenja tumora i potencijalne invazije svoda lobanje (kalvarje) i dure, zauzimajući važno mesto u preoperativnom planiranju i zbrinjavanju.

Ključne reči:
dijagnoza; histološke tehnike; imunohistohemija; magnetska rezonanca, snimanje; neoplazme, invazivnost; karcinom, planocelularni; neurohirurške procedure; skalp.

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Introduction

Around 2% of all cutaneous neoplasms arise in the scalp and can be classified as either primary scalp tumors (epithelial, melanocytic, adnexal) or metastatic [1, 2]. In adult populations, 93–98% of scalp lesions are benign, with the most common lesion being trichilemmal cysts, followed by epidermal cysts, lipoma, nevi, and sebaceous cysts, while primary malignant tumors of the scalp are rare [3–6]. Skull and dural infiltration is rare in cutaneous malignancies but can generally occur if left untreated [6, 7]. Squamous cell carcinoma (SCC) is the second most common subtype of nonmelanoma skin cancer after basal cell carcinoma (BCC), representing about 20% of these tumors. Like BCCs, the incidence of SCCs is increasing throughout the world, with risk factors including ultraviolet radiation exposure, age, fair skin, history of skin cancer, actinic damage, and immunosuppression [8]. About 3–8% of SCCs are located on the scalp and, if left untreated, can cause skull and dural invasion [4].

We present a case of a large, initially untreated scalp lesion, proven to be SCC with invasion of the underlying calvaria and dura.

Case report

A 49-year-old male patient presented with a large and painful cutaneous lesion in the left parietooccipital region of the head. Physical examination revealed a large cauliflower-like, partially necrotic, painful lesion with peripheral subcutaneous induration and erythema. The lesion had previously been neglected for some time, and the patient finally got consulted because of rapid growth in the few months leading up to the examination. There were no signs of neurological impairment, and no other symptoms were present. Magnetic resonance imaging (MRI) revealed a large inhomogeneous lesion in the left parietooccipital region with intracranial extension and dural infiltration. The tumor was predominantly T2 weighted (T2W)/T1 weighted (T1W) isointense with prominent zones of T2W hyperintensity, suggesting cystic degeneration or necrosis (Figure 1). There were no signs of diffusion restriction. No foci of succeptibility weighted imaging (SWI) hypointense signal were detected. The lesion showed significant inhomogeneous contrast enhancement with extensive zones of hypovascularity, suggesting necrosis. The lesion was localized near the displaced superior sagittal sinus (SSS) without an evident defect after administration of paramagnetic contrast (Figure 2). The specificity of this lesion is in its size, location, and invasivity, as similar lesions have been rarely encountered, let alone treated and pathohistologically verified, due to the often poor condition of the patient. Owing to his good clinical condition, the patient underwent surgical removal of the tumor with excision of invaded skin, bone, and dura with a safety margin of 1 cm; as the invasion of SSS was not observed intraoperatively, gross total removal was confirmed by the neurosurgeon. The excised dural portion was reconstructed with an autograft that was taken from the fascia lata. Craniotomy planning was performed preoperatively virtually, followed by three-dimensional (3D) printing of craniotomy bone cutting guide and, subsequently, after 3D-guided preplanned craniotomy, the cranial implant was custom prefabricated *via* 3D-printed molds used to shape the polymethylmetacrilate implant under sterile conditions, which had a perfect fit intraoperatively. That was an important treatment step needed to achieve better functional and aesthetic outcomes as well as speed up the surgery time and reduce complications rate such as bleeding, primarily, and the need for excessive drilling that could potentially lead

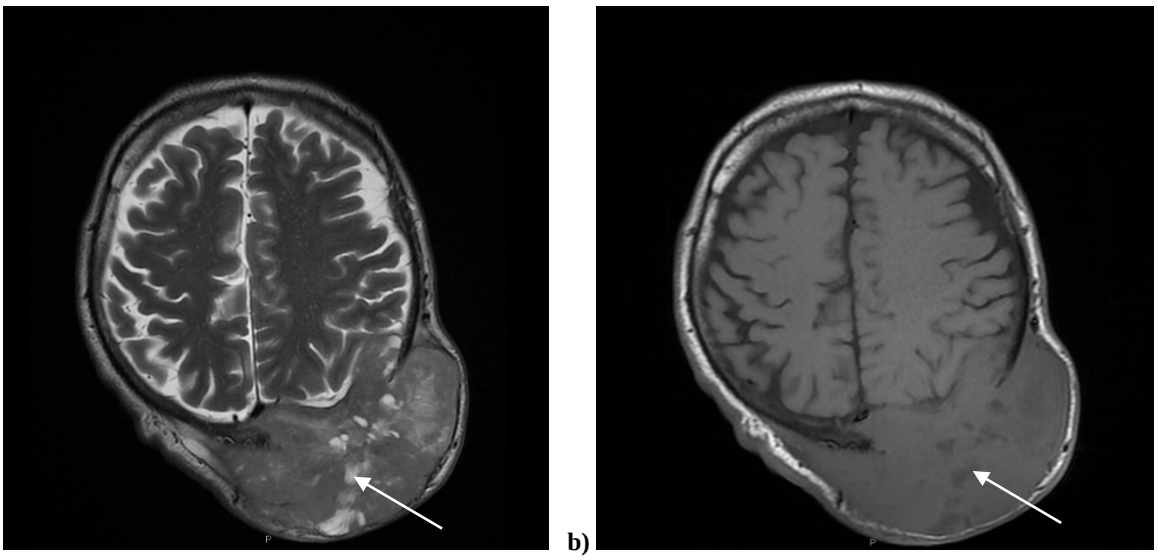

Fig. 1 – Magnetic resonance imaging of the brain. a) Transversal T2W image; b) Transversal T1W image. Large inhomogeneous tumor in the left parietooccipital region with intracranial extension. The lesion is predominantly T2W/T1W isointense with zones of T2W hyper/T1W hypointensity (indicated by arrow). T2W – T2 weighted; T1W – T1 weighted.

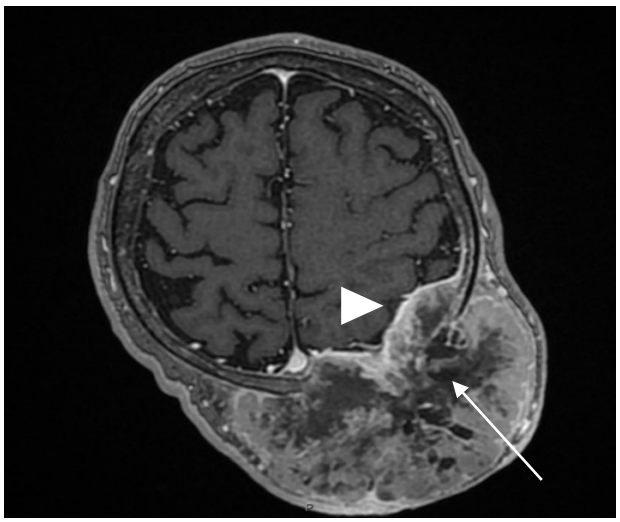

Fig. 2 – Magnetic resonance imaging of the brain. Transversal 3DT1W images after paramagnetic contrast administration. Prominent inhomogeneous signal alteration of the lesion with extensive zones of hypovascularity suggesting necrosis (indicated by →). Signs of dural infiltration (indicated by ►). The lesion is localized near the displaced superior sagittal sinus with no evident contrast defect. 3DT1W – 3D T1 weighted image.

to dural and/or thermic injury. Pathohistological (PH) analysis revealed invasive SCC (Figure 3) with immunohistochemistry staining, which revealed CK5/6 and CK7 positivity (Figure 4). A postoperative computed tomography (CT) scan was performed, which showed no signs of surgical complications (Figure 5).

Discussion

SCCs of the scalp are usually diagnosed before the invasion of the skull due to their progressive and slow extension. However, the possibility of skull and dural infiltration exists in the late stages of development, with very

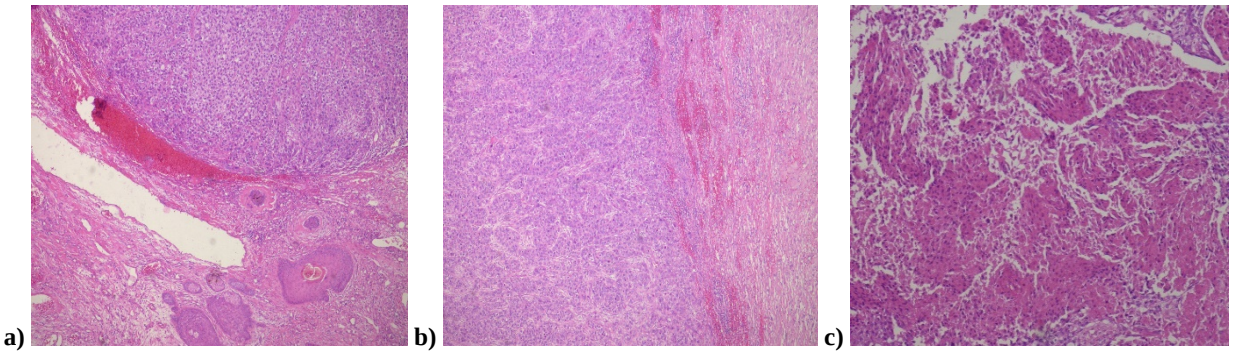

Fig. 3 – Pathohistology, hematoxylin and eosin staining; a) Squamous cell carcinoma (SCC) in the dermis; b) Dural invasion; c) Dyskeratosis in SCC. Magnifications ×50 (a,b), ×100 (c).

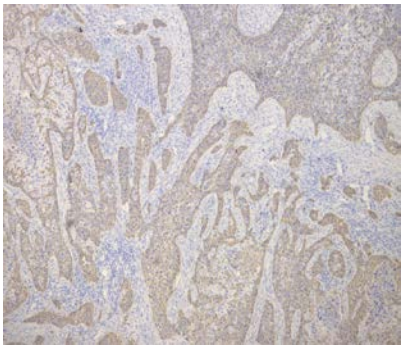

Fig. 4 – Immunohistochemistry finding shows CK5/6 positive reaction verifying squamous differentiation of tumor (magnification ×50).

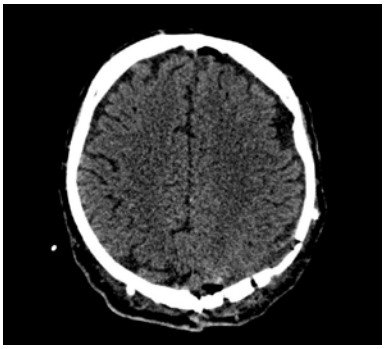

Fig. 5 – Postoperative computed tomography, axial non-contrast slices. No signs of surgical complications.

few cases involving the adjacent brain [9]. As some SCCs of the scalp are diagnosed at this advanced stage, this location may be considered an independent risk factor for poor prognosis [4, 10].

BCC and SCC are the two most common types of malignant cutaneous tumors of the scalp accounting for 41% and 17% of cases, respectively, with 12–18% of BCCs and 3–8% of SCCs being located on the scalp [4, 10, 11]. Other, albeit less common, malignant lesions of the scalp include malignant melanoma, angiosarcoma, Merkel cell carcinoma, and metastasis. BCCs and SCCs are indistinguishable on MRI, with both tumors showing nonspecific T1W hypointensity and iso-hyperintensity on T2W images, and both lesions often having central recesses [12]. A scalp-localized dermatofibrosarcoma protuberans (DFSP), which is a rare locally aggressive sarcoma of the dermis, can have a similar imaging presentation, although the lesion is much slower growing and painless. On T1W images, DFSP is isointense, with a variable T2W signal, mostly hyperintense, sometimes iso- or hypointense. Contrast enhancement pattern in DFSP ranges from mild to markedly heterogeneous or homogeneous [13].

While the vast majority of skin cancers can be treated based on clinical features alone, large and aggressive tumors that may compromise vital structures demand radiologic imaging for a detailed assessment and further optimal management. Skin cancers that most frequently require imaging are SCC, BCC, DFSP, and Merkel cell carcinoma [14]. Both locally aggressive BCCs and SCCs of the forehead and scalp have been shown to potentially infiltrate the underlying bone, with dural and brain parenchyma invasion in very rare cases, more common in BCCs [15, 16]. The presence of a large, firm, tender mass of the scalp, with focal tenderness over a bony margin, should raise suspicion of bony invasion and warrant imaging [14].

Imaging modalities (CT and MRI) are of great value in evaluating potential skull and dural involvement and thus play an important role in planning a preoperative strategy. CT is more accurate for identifying bony invasion, while MRI is superior in detecting dural and brain involvement [7]. Depth of invasion of SCC is a significant factor for the prognosis and outcome of patients, and these radiology modalities play a significant role in detecting any changes in the brain structure [17].

The rate of a correct preoperative diagnosis for scalp lesions is usually lower among general surgery, neurosurgery, and plastic surgery departments, which may be caused by a lack of diagnostic expertise in scalp lesions [3, 10]. Therefore, careful assessment and understanding of imaging characteristics are important in forming a more accurate preoperative diagnosis while the definitive diagnosis is established with PH verification. Additionally, the importance of this specific lesion lies in the specific clinical steps administered preoperatively and intraoperatively concerning the rarity, location, invasiveness, and aesthetical appearance of the lesion.

The surgical approach and management strategy are dependent on the degree of infiltration, with cooperation among different specialists required in the most complex of cases. In tumors with calvarial and dural involvement, generous excision of all small tissues with parts of the invaded skull and dura offers the best chance for preventing tumor recurrence with adequate dural reconstruction, preferably with autograft, followed by bone reconstruction with novel reconstruction techniques and materials, if available [6, 18, 19].

Furthermore, CT and MRI modalities are of great importance for bone reconstruction because 3D printing is performed on their basis using images, which indicates the even greater importance of radiological tools in many clinical areas. That serves to emphasize the current need to embrace the technology so the best treatment of surgical outcomes can be achieved [20, 21].

Conclusion

If left untreated, some cases of scalp SCCs can cause invasion of the underlying skull and dura. Imaging modalities like CT and MRI play a crucial role in evaluating the degree of neoplastic extension and potential calvarial and dural invasion, thus being of significant importance in preoperative planning, management, and clinical outcome of the patient.

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