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Inaugural Giant 18-cm Solid-Cystic Plasmacytoma of the Calvaria with Superior Sagittal Sinus Invasion: A Rare Mimicker of Aggressive Primary Bone Tumors

M. Aabid[1]*, N. Ebbadi[1], S. Soufi[1], Y. Bouktib[1], A. El Hajjami[1], F. Amenzouy[1], B. Boutakaiout[1], M. Ouali Idrissi[2], N. Idrissi El Ganouni[1]

[1]Department of Radiology, Arrazi Hospital, Mohammed VI University Hospital Center (CHU), Marrakech, Morocco
[2]Department of Pathology, Mohammed VI University Hospital Center (CHU), Marrakech, Morocco

***Corresponding author:** M. Aabid
Department of Radiology, Arrazi Hospital, Mohammed VI University Hospital Center (CHU), Marrakech, Morocco

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Abstract: Case Report

Background: Giant calvarial plasmacytoma is an exceptional inaugural presentation of Multiple Myeloma (MM), often posing a diagnostic challenge due to its aggressive radiological appearance and atypical cystic components. ***Case Presentation***: A 56-year-old male presented with a massive, rapidly progressive frontal mass (18 cm) evolving over 15 months. MRI revealed a voluminous solid-cystic lesion causing extensive bone destruction, invading the superior sagittal sinus (SSS) and the left orbit. Functional MRI (DWI/ADC) suggested high cellularity, while venous TOF-MRA confirmed the amputation of the anterior SSS. Systemic staging via PET-CT identified a hypermetabolic D6 vertebral lesion. Histopathology of the cranial mass confirmed a plasmacytic proliferation, establishing the diagnosis of Multiple Myeloma. ***Conclusion***: This spectacular case emphasizes the need to include plasma cell dyscrasias in the differential diagnosis of giant cystic-solid skull tumors and highlights the critical role of advanced neuroimaging in evaluating dural and venous sinus involvement for surgical and oncological planning.

Keywords: Multiple Myeloma, Plasmacytoma, Skull Vault, Superior Sagittal Sinus, Magnetic Resonance Imaging, PET-CT.

1. INTRODUCTION

Multiple myeloma (MM) is a hematological malignancy characterized by the monoclonal proliferation of plasma cells within the bone marrow. While skeletal involvement is a hallmark of the disease, its inaugural presentation as a giant exophytic calvarial mass is rare, occurring in less than 1% of cases [1, 2]. These tumors typically present as solitary or multiple lytic "punched-out" lesions; however, when they reach massive proportions, they can mimic aggressive primary bone sarcomas or necrotic metastases [3]. Involvement of the dural venous sinuses is an infrequent but severe complication that significantly increases the risk of venous infarction and surgical morbidity [4]. We report a spectacular case of an 18-cm solid-cystic cranial plasmacytoma that served as the revealing sign of Multiple Myeloma.

2. Case Presentation

A 56-year-old male with no prior medical history presented with a massive, painless frontal swelling that had grown rapidly over the preceding 15 months. Physical examination revealed a giant, firm, and non-pulsatile scalp mass with significant collateral venous circulation **(Figure 1)**.

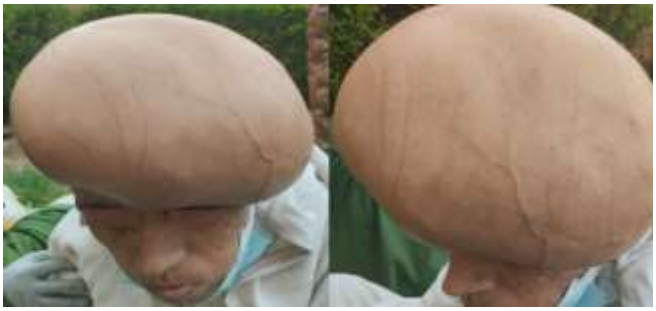

Figure 1: Clinical presentation: Frontal and lateral photographs showing a massive scalp tumor with prominent superficial venous congestion

Initial skull radiography confirmed extensive, irregular osteolytic areas involving the fronto-parietal vault with characteristic "punched-out" patterns **(Figure 2)**.

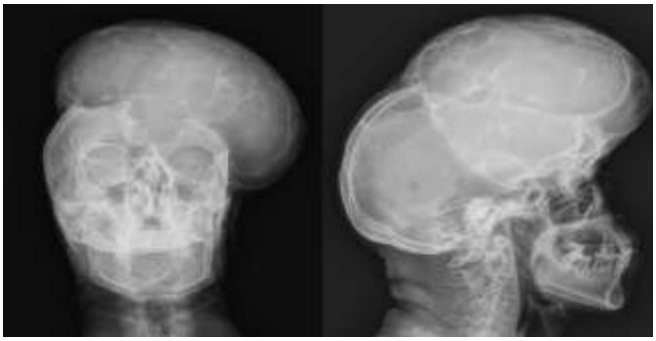

Figure 2: Skull Radiography: AP and Lateral views demonstrating extensive "punched-out" osteolytic lesions and massive destruction of the frontal and parietal bones

Brain MRI was performed to evaluate the intracranial extension. It demonstrated a voluminous (18 x 18 x 14.6 cm) solid-cystic extra-axial process. The solid central component exhibited intermediate T1 and high T2/FLAIR signals. A peripheral multiloculated cystic component was noted with septal enhancement after contrast administration **(Figure 3)**. The tumor caused extensive bone lysis of the cranium, extended into the left frontal sinus, and invaded the left orbit, infiltrating the extraconal fat and the optic nerve **(Figure 3C)**.

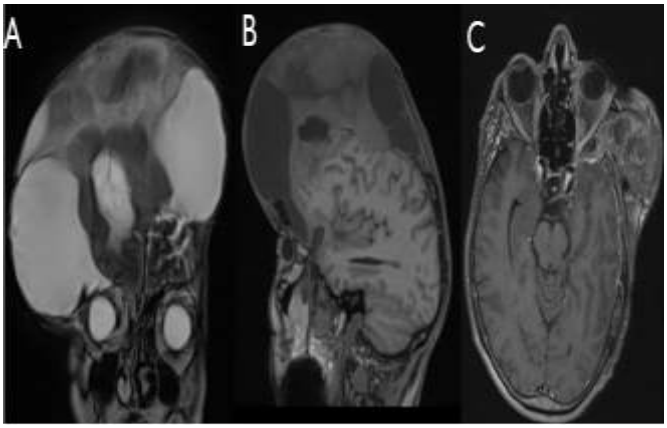

Figure 3: MRI Morphological Assessment: (A) Coronal T2-weighted MRI showing the multiloculated solid-cystic architecture. (B) Sagittal T1-weighted image showing the massive exophytic and downward cranio-facial extension. (C) Post-contrast axial T1-weighted image showing dural infiltration and orbital invasion

Advanced functional and vascular sequences were integrated into the MRI protocol. Diffusion-weighted imaging (DWI) and the corresponding ADC map showed restricted diffusion within the solid components, reflecting high nuclear-to-cytoplasmic ratios. Venous TOF-MRA was utilized to assess the patency of the dural sinuses, revealing a complete amputation of the anterior third of the superior sagittal sinus **(Figure 4)**.

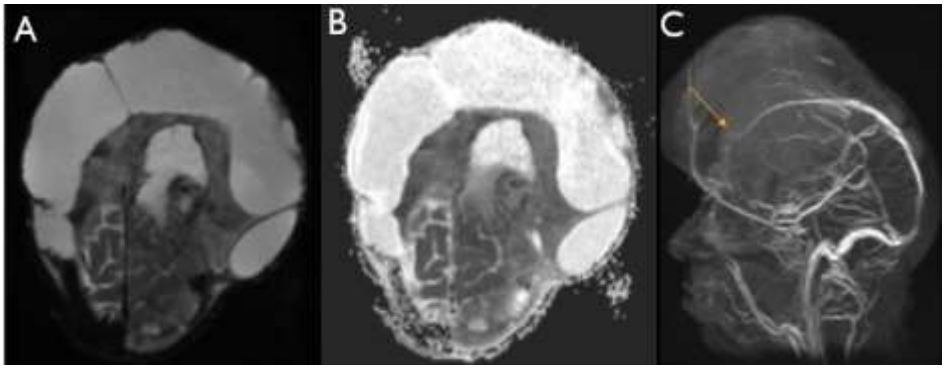

Figure 4: Functional and Vascular Imaging: (A) Diffusion-weighted imaging (DWI) and (B) ADC map showing restricted diffusion within the solid tumor components, suggestive of high cellular density. (C) Venous TOF-MRA (Lateral projection) showing the complete amputation of the anterior third of the superior sagittal sinus (white arrow)

Systemic staging via 18F-FDG PET-CT identified the high hypermetabolism of the cranial mass and a suspicious secondary hypermetabolic lesion at the D6 vertebral level. Histopathological analysis of biopsy fragments confirmed a diffuse infiltration of round cells with plasmacytic differentiation, leading to the final diagnosis of Multiple Myeloma.

3. DISCUSSION

The discovery of a giant calvarial mass in an adult requires a systematic diagnostic approach to differentiate between primary bone tumors, meningiomas, and secondary metastatic disease [6].

3.1. Radiological Characteristics and Diagnostic Pitfalls

Calvarial plasmacytomas typically appear as well-circumscribed lytic lesions. However, our case is remarkable for its **solid-cystic multiloculated morphology**. This atypical appearance can lead to diagnostic pitfalls, mimicking necrotic metastases (from renal or thyroid carcinoma) or aggressive primary bone tumors like osteosarcomas [3, 7]. On MRI, the low ADC values in the solid portions of the mass are a key indicator of small-round-cell tumors, such as plasmacytoma, due to their high cellular density [8].

3.2. Superior Sagittal Sinus (SSS) Invasion

A critical feature of this case is the invasion and amputation of the anterior SSS. While dural involvement is reported in large plasmacytomas, frank venous sinus occlusion is rare [4, 10]. Venous TOF-MRA is an essential tool for assessing sinus patency **(Figure 4C)**. In our patient, the SSS amputation indicates either endoluminal tumor thrombus or severe extraluminal compression, both of which significantly increase the risk of venous infarction [11].

3.3. The Role of PET-CT in Staging

While MRI is superior for evaluating local extension, PET-CT is now mandatory for the staging of plasma cell dyscrasias [5]. In this case, identifying a hypermetabolic lesion at D6 reclassified the patient from "Solitary Bone Plasmacytoma" to "Multiple Myeloma." This distinction is vital as it shifts the management from local radiotherapy to systemic chemotherapy and potentially autologous stem cell transplantation [12, 13].

4. CONCLUSION

A giant calvarial mass with multiloculated cystic components and venous sinus invasion can be the inaugural sign of Multiple Myeloma. MRI with DWI and venous TOF sequences is the modality of choice for local staging, while PET-CT remains mandatory for systemic evaluation and accurate diagnosis.

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