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Mini Review

Isolated Adrenal Metastases: Rethinking a Solitary Lesion in the Era of Precision Oncology

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Abstract

Isolated adrenal metastases (IAM) have traditionally been viewed as a marker of systemic disease and poor prognosis. However, emerging evidence challenges this paradigm, suggesting that IAM may represent a biologically distinct and potentially curable state in selected patients. Advances in imaging, molecular profiling, and minimally invasive surgical techniques have reshaped diagnostic and therapeutic approaches. This article explores IAM through a contemporary lens, emphasizing tumor biology, oligometastatic theory, and individualized treatment strategies. By integrating radiologic precision, genomic insights, and multidisciplinary care, IAM may transition from a terminal finding to a targetable condition with meaningful survival benefits. This evolving perspective calls for a redefinition of clinical pathways and highlights the need for prospective studies to validate aggressive local therapies in carefully selected cohorts

Introduction

The adrenal glands are among the most common sites of metastatic spread due to their rich sinusoidal blood supply. While adrenal metastases frequently occur in the context of widespread disease, isolated adrenal metastases—defined as solitary adrenal involvement without evidence of metastasis elsewhere—present a unique clinical challenge. Historically, their detection signaled advanced disease, often relegating patients to palliative management. However, the concept of oligometastasis has reframed this narrative, proposing that limited metastatic burden may be amenable to curative intent therapies.

in vesicles and processed in secretory granules before

Epidemiology and Primary Tumor Associations

IAM most commonly arise from primary malignancies such as non-small cell lung cancer, renal cell carcinoma, melanoma, and colorectal cancer. The incidence varies depending on tumor biology and surveillance practices. Notably, lung cancer accounts for the majority of cases, with the adrenal gland being a frequent first site of distant spread.

Pathophysiology: Beyond Hematogenous Spread

While hematogenous dissemination remains the primary mechanism, recent studies suggest that microenvironmental factors within the adrenal cortex may favor metastatic colonization. The adrenal glands immunologically permissive niche, coupled with high vascularity, may allow tumor cells to evade immune surveillance. Additionally, emerging molecular data indicate that certain tumors exhibit adrenal tropism driven by specific gene expression profiles

DiagnosticAdvances

Accurate differentiation between benign adrenal adenomas and metastatic lesions is critical. Modern imaging modalities have significantly improved diagnostic accuracy

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- **Computed Tomography (CT):** Washout characteristics help distinguish lipid-rich adenomas from metastases.
- **Magnetic Resonance Imaging (MRI):** Chemical shift imaging enhances tissue characterization.
- **Positron Emission Tomography (PET-CT):** Provides functional assessment and detects occult metastases elsewhere

Biopsy remains reserved for indeterminate cases where imaging is inconclusive and results would alter management.

Therapeutic Strategies

1. **Surgical Resection (Adrenalectomy):** Laparoscopic adrenalectomy has become the standard approach for resectable IAM. Studies report 5-year survival rates ranging from 25–40% in selected patients, particularly those with lung and renal primaries.
2. **Stereotactic Body Radiotherapy (SBRT):** SBRT offers a non-invasive alternative with high local control rates (>80%) and minimal toxicity, making it suitable for patients unfit for surgery.
3. **Systemic Therapy Integration:** The advent of targeted therapies and immunotherapy has transformed outcomes. In some cases, systemic treatment may downstage disease, enabling subsequent local intervention.
4. **Thermal Ablation Techniques:** Radiofrequency and microwave ablation are emerging modalities for small lesions, particularly in high-risk surgical candidates.

Conclusion

Isolated adrenal metastases should no longer be viewed solely as a harbinger of terminal disease. Instead, they represent a nuanced clinical entity at the intersection of systemic and localized cancer. With advances in diagnostics and therapeutics, a subset of patients may achieve long-term survival or even cure. Embracing a multidisciplinary, biology-driven approach is essential to unlocking this potential and redefining outcome in metastatic cancer

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