Impact of Liquid Biopsies on Early Detection, Monitoring, and Prognostication in Prostate Cancer: A Meta-Analysis of Emerging Evidence

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Background

- Prostate cancer remains a leading cause of cancer-related morbidity and mortality among men worldwide.
- Traditional diagnostic and monitoring techniques often lack sensitivity and specificity, particularly in early stages.
- Liquid biopsies, which analyze circulating tumor cells (CTCs) and circulating tumor DNA (ctDNA) from blood samples, have emerged as a promising non-invasive alternative for early detection, monitoring disease progression, and prognostication

Methods

- Outcomes were pooled as untransformed proportions using a random-effects model.
- Meta-analyses were conducted using R Studio 5.3.
- A total of 30 studies involving 5,200 prostate cancer patients were included in the meta-analysis.

Databases searched

PubMed® Cochrane Embase® ClinicalTrials.gov A service of the U.S. National Institutes of Health

Screening and Data Extraction

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Statistical Analysis

- **Software:** Statistical analyses were conducted using R Studio 5.3.
- **Effect Measures:**
- *Proportions* with 95% CIs for sensitivity and specificity were pooled.
- Subgroup analyses were performed to assess the diagnostic accuracy, prognostic value, and clinical utility of CTCs and ctDNA.
- An I^2 value of >50% was considered significant heterogeneity.

Results

- Liquid biopsies demonstrated a pooled sensitivity of 85% (95% CI: 80%-90%) and a specificity of 88% (95% CI: 83%-92%) for early detection of prostate cancer.
- CTCs and ctDNA levels were significantly correlated with tumor burden, Gleason score, and metastatic potential.
- Furthermore, elevated levels of CTCs and ctDNA were associated with poorer overall survival and progression-free survival, underscoring their prognostic value.

Conclusion

- Liquid biopsies demonstrate strong potential as a non-invasive tool for early detection, monitoring, and prognostication in prostate cancer.
- The pooled sensitivity (85%) and specificity (88%) highlight their diagnostic accuracy compared to traditional methods.
- Circulating tumor cells (CTCs) and circulating tumor DNA (ctDNA) levels were significantly associated with tumor burden, Gleason score, and metastatic risk, reinforcing their prognostic significance.
- Elevated CTC and ctDNA levels correlated with reduced overall and progression-free survival, indicating their clinical relevance in disease monitoring.
- findings support the integration of liquid biopsy techniques into prostate cancer management.
- Further standardization and large-scale validation are needed to ensure consistent clinical application.

References