

ABSTRACT

Background: Osteosarcoma is the most common primary malignant bone tumor found in children and adolescents, with the highest incidence occurring during the second decade of life. Despite advances in multimodal therapy, clinical outcomes remain variable and are influenced by numerous factors. Simple biomarkers such as Vitamin D and LDH hold potential as prognostic indicators, but their roles have not been extensively studied in the clinical context of Indonesia. Vitamin D exerts protective effects on the musculoskeletal system and may inhibit tumor cell proliferation, thereby potentially providing a favorable prognostic effect in osteosarcoma. In contrast, lactate dehydrogenase (LDH) has been shown to serve as an indicator of tumor aggressiveness, making it an unfavorable prognostic marker.

Aim: To evaluate the association between serum levels of Vitamin D and LDH with disease stage, functional outcomes, and survival in osteosarcoma patients at Dr. Sardjito General Hospital, Yogyakarta.

Methods: This study is a cross-sectional design involving pediatric and adult patients diagnosed with osteosarcoma at Dr. Sardjito General Hospital, Yogyakarta, Indonesia. Serum levels of vitamin D and lactate dehydrogenase (LDH) were measured at the time of diagnosis and correlated with clinical and histopathological data, including tumor stage, treatment modalities, and clinical outcomes. Statistical analyses were performed to evaluate the associations between these biochemical biomarkers and tumor characteristics and outcomes, as well as to assess their prognostic potential in osteosarcoma management.

Results: A total of 28 osteosarcoma patients were analyzed to evaluate the association between vitamin D and LDH levels with 1-year survival. The mean serum vitamin D level was 15.17 ± 2.73 ng/mL and LDH was 487.25 ± 570.34 U/L. ROC analysis showed no statistically significant predictive value for either biomarker (vitamin D: AUC 0.468, $p=0.801$; LDH: AUC 0.615, $p = 0.361$). Kaplan–Meier analysis also showed no significant differences in mean survival based on vitamin D or LDH levels, whether using average or ROC-based cut-offs ($p>0.05$). Cox regression confirmed that neither vitamin D nor LDH were independent prognostic factors for survival (vitamin D HR 0.96, 95% CI 0.29–3.24; LDH HR 1.000, 95% CI 0.944–1.059). Furthermore, no significant associations were found between these biomarkers and functional outcomes based on MSTs scores. These findings suggest that serum vitamin D and LDH levels may have limited utility as prognostic indicators in osteosarcoma patients.

Conclusion: This study showed that vitamin D and LDH levels have not been proven to be significant prognostic predictors in osteosarcoma patients. Although the average vitamin D level tended to be low and LDH level high, no meaningful associations were found with survival or functional outcomes. These findings indicate the need for cautious interpretation and further studies with more robust design and larger sample sizes.

Keywords: Osteosarcoma, Vitamin D, Lactate Dehydrogenase, Prognostic Biomarker, Survival Analysis, Functional Outcome, MSTs Score, Cox Regression

ABSTRAK

Latar Belakang: Osteosarkoma merupakan tumor tulang ganas primer yang paling sering ditemukan pada anak dan remaja, dengan insidensi tertinggi pada dekade kedua kehidupan. Terlepas dari kemajuan terapi multimodal, luaran klinis masih bervariasi dan dipengaruhi oleh banyak faktor. Biomarker sederhana seperti Vitamin D dan LDH berpotensi digunakan dalam menilai prognosis, namun belum banyak diteliti dalam konteks klinis Indonesia. Vitamin D sendiri memiliki efek protektif terhadap sistem muskuloskeletal dan dapat menghambat proses proliferasi dari sel tumor, sehingga diharapkan dapat memberikan efek prognostik baik terhadap Osteosarkoma. Sedangkan LDH sendiri telah terbukti dapat menjadi indikator tingkat agresivitas tumor, sehingga dapat menjadi marker prognostik yang tidak baik.

Tujuan: Menilai hubungan kadar Vitamin D dan LDH dengan stadium penyakit, luaran fungsional, dan kesintasan pasien osteosarkoma di RSUP Dr. Sardjito Yogyakarta.

Metode: Penelitian ini merupakan studi cross-sectional yang merekrut pasien pediatrik dan dewasa dengan diagnosis osteosarkoma di RSUP Dr. Sardjito Yogyakarta, Indonesia. Kadar vitamin D dan laktat dehidrogenase (LDH) diukur dari sampel darah saat diagnosis ditegakkan, serta dikaitkan dengan data klinis dan histologis pasien, termasuk stadium tumor, modalitas terapi, dan luaran klinis. Analisis statistik dilakukan untuk mengevaluasi hubungan antara biomarker biokimia tersebut dengan karakteristik tumor dan luaran klinis, serta menilai potensi prognostik kedua biomarker tersebut dalam manajemen osteosarkoma

Hasil: Sebanyak 28 pasien osteosarkoma dianalisis untuk mengevaluasi hubungan kadar vitamin D dan LDH dengan luaran 1-year survival. Rerata kadar vitamin D adalah $15,17 \pm 2,73$ ng/mL dan LDH sebesar $487,25 \pm 570,34$ U/L. Analisis ROC menunjukkan bahwa kedua biomarker tidak memiliki nilai prediktif yang signifikan secara statistik (vitamin D: AUC 0,468; $p=0,801$; LDH: AUC 0,615; $p=0,361$). Analisis Kaplan–Meier juga tidak menunjukkan perbedaan bermakna dalam rerata kelangsungan hidup berdasarkan kadar vitamin D maupun LDH, baik dengan cut-off rata-rata maupun cut-off ROC ($p>0,05$). Analisis regresi Cox menegaskan bahwa vitamin D maupun LDH bukan merupakan faktor prognostik independen (HR vitamin D 0,96; 95% CI 0,29–3,24; HR LDH 1,000; 95% CI 0,944–1,059). Selain itu, tidak ditemukan hubungan signifikan antara kedua biomarker dengan luaran fungsional berdasarkan skor MSTs. Temuan ini menunjukkan bahwa kadar vitamin D dan LDH serum memiliki keterbatasan dalam memprediksi prognosis pasien osteosarkoma.

Kesimpulan: Penelitian ini menunjukkan bahwa kadar vitamin D dan LDH belum terbukti signifikan sebagai prediktor prognosis pasien osteosarkoma. Meskipun rerata kadar vitamin D cenderung rendah dan LDH tinggi, tidak ditemukan hubungan bermakna terhadap kelangsungan hidup maupun luaran fungsional. Temuan ini mengindikasikan perlunya interpretasi hati-hati serta dukungan studi lanjutan dengan desain dan ukuran sampel yang lebih memadai.

Kata Kunci: Osteosarkoma, Vitamin D, Laktat Dehidrogenase, Biomarker Prognostik, Analisis Survival, Luaran Fungsional