The incidence and role of EBV and HIV in head and neck lymphomas: an institutional study

Buntu Xoki, BChD, MChD, FCMFOS(SA),[a] Andries Masenge, MSc,[b] and Tsholofelo Kungoane, BDS, MDENT, FC SA (PATH) Oral[c]

Objectives. To determine the prevalence of Epstein-Barr virus (EBV) positive lymphomas in a cohort of patients with head and neck lymphomas and to correlate these lymphomas with HIV status, $CD4^+$ cell count, clinical stage, and overall survival.

Study Design. This retrospective descriptive study sourced data from pathology reports and clinical records. Data collected included lymphoma type, HIV status, and medical information related to immunosuppression, $CD4^+$ T-cell counts, HIV viral load, Ann Arbor clinical stage, and follow-up data.

Results. We reviewed 228 lymphomas, comprising 9 Hodgkin lymphomas and 219 non-Hodgkin lymphomas (HIV-positive: 133; HIV-negative: 23, and unknown HIV status: 72). Diffuse large B-cell lymphoma and plasmablastic lymphoma (PBL) were common and associated with HIV immune suppression, male sex, and middle age. Seventy-four lymphomas were Epstein-Barr encoded RNA in situ hybridization (EBER-ISH) positive. PBL was the most common EBV-driven lymphoma (median $CD4^+$ count = 147 cells/mm^3), with the highest Ann Arbor staging.

Conclusion. These findings suggest that EBV infection is among the primary factors contributing to PBL oncogenesis in HIV-positive patients. Patients with PBL presented with $CD4^+$ T-cell counts of <400 cells/mm^3. Patients with HIV infection had a lower overall survival rate compared to HIV-negative patients, irrespective of lymphoma type. (Oral Surg Oral Med Oral Pathol Oral Radiol 2026;141:106−115)

South Africa has an estimated 8 million people living with HIV infection,[1] some of whom present with HIV/AIDS-defining malignancies. People living with HIV/AIDS (PLWHA) are prone to developing viral-induced malignancies associated with oncogenic viruses such as human papillomavirus (HPV), Epstein-Barr virus (EBV), and human herpes virus 8 (HHV8). These viruses are prominent in the pathogenesis of head and neck HIV/AIDS malignancies,[2] which is amplified in the background of HIV viremia and immunosuppression.[3,4] The role of immunosuppression in driving the development of EBV-associated hematolymphoid malignancies in PLWHA is mainly through the reduction in $CD4^+$ T-lymphocytes and T-cell dysregulation that occur during HIV replication.[5] The incidence of hematolymphoid neoplasms among PLWHA is reported to be higher than in the general population and is associated with morbidity and mortality among PLWHA.[6,7]

EBV is a DNA virus that belongs to the human herpesvirus family and infects B-lymphocytes using the CD21 receptor.[8] Infection of B-lymphocytes is known to contribute to the development of lymphoproliferative disorders, especially lymphomas.[9,10] EBV oncogenesis mainly occurs through the expression of viral genes during viral latency which helps to maintain the viral genome and evade the host immune system.[9,10] These genes drive B-cell proliferation which may lead to additional mutations such as activation of the *MYC* oncogene, and malignant transformation.[11]

This study aimed to determine the incidence of head and neck lymphomas at Pretoria Oral and Dental Hospital, South Africa, from January 2011 to December 2021 and to correlate these HNLs with HIV infection and EBV status. This study also investigated the role of both viruses in lymphoma development and patient outcomes.

METHODS

Study design

This was a retrospective descriptive study of pathology reports, clinical and oncology records of patients diagnosed with head and neck lymphomas at the Oral and

Statement of Clinical Relevance

This study highlights the significant correlation between HIV infection and EBV-positive lymphomas in the head and neck regions, underscoring the need for vigilant screening and management strategies for lymphoma in HIV-positive patients to improve clinical outcomes.

[a]Department of Maxillofacial and Oral Surgery, School of Dentistry, University of Pretoria, Pretoria, South Africa.
[b]Department of Statistics, University of Pretoria, Pretoria, South Africa.
[c]Department of Oral and Maxillofacial Pathology, School of Dentistry, University of Pretoria, Pretoria, South Africa.
Corresponding author: Tsholofelo Kungoane E-mail address: Tsholofelo.Kungoane@up.ac.za
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Dental Hospital, Pretoria, South Africa. This study was conducted in accordance with the Declaration of Helsinki. The study protocol and ethics were approved by the Faculty of Health Sciences Research Ethics Committee (reference number: 692/2021).

Patient selection

All head and neck lymphoma cases diagnosed from January 1, 2011 to December 31, 2021, with pathology reports were included. Consultation and nonhead and neck cases were excluded. Demographic characteristics and disease variables were obtained by reviewing the clinical records from the Maxillofacial and Oral Surgery Department at the Oral and Dental Hospital and the oncological records from the Medical Oncology Department at Steve Biko Academic Hospital in Pretoria, South Africa.

Review of the histology reports and slides

An electronic search of all pathology reports was performed using the term "lymphoma." The slides of the lymphoma cases were retrieved and reviewed by the authors. No additional immunohistochemistry (IHC) staining was performed. The histological evaluation included a review of pathology reports and slides, including hematoxylin and eosin, IHC, and Epstein-Barr encoded RNA in situ hybridization (EBER-ISH) slides by an Oral and Maxillofacial pathologist (T.K.). Lymphoma diagnosis was based on the 2016 revision of the World Health Organization (WHO) classification of lymphoid neoplasms at the time of diagnosis.[12]

The histological data collected included lymphoma type and site, IHC staining patterns, and EBER-ISH status. The pathology reports were correlated with the clinical and oncological records. Data captured from the clinical records included HIV status and other medical information related to immunosuppression, $CD4^+$ T-cell counts, HIV viral load, antiretroviral therapy (ART) status (naïve, defaulted, on treatment), Ann Arbor clinical stage,[13] and follow-up data. The estimated overall survival (OS) was defined as the time from the date of diagnosis to the date of death or last follow-up. The follow-up end-point was June 22, 2022. The follow-up time was recorded in months.

Statistical analysis

Raw data were collected using an Excel spreadsheet and analyzed using SPSS version 22.0 (SPSS for Windows Inc., Chicago, IL). Descriptive statistics were calculated for demographic and clinical characteristics and expressed as frequencies and percentages. The chi-square test was used to determine the relationship between EBV lymphoma type and HIV status. Mann-Whitney and Kruskal-Wallis nonparametric tests were performed to determine the associations between lymphoma type, EBV status, $CD4^+$ cell count, and viral load. The OS rate was estimated using Kaplan-Meier analysis and compared using a log-rank test. Significance was set at $P < .005$.

RESULTS

Patient demographics

A total of 228 head-and-neck lymphomas were identified from pathology records. Of these, 9 (3.9%) were Hodgkin lymphomas (HLs) and 219 (96.1%) were non-Hodgkin lymphomas (NHLs). The majority of the patients were male 146 (64%) compared to 84 (36%) female. The median age at lymphoma diagnosis was 43.7 years (range, 1.7-81 years). A significant proportion of cases were noted in the age range of 35-60 years ($P < .001$). The maxilla was the most common site, 65 (28.5%). The patient characteristics are summarized in Table I.

Head and neck lymphoma subtypes

Of the 9 HL cases, 4 (44.4%) and 2 (22.2%) were mixed cellularity and nodular sclerosing, respectively. There was only one case each of lymphocyte-rich, nodular lymphocyte predominant, and HL not otherwise specified. Of the 219 NHL cases, 3 (1.3%) were T-cell lymphomas, 11 (4.8%) were plasma cell neoplasms, and 204 (89.4%) were B-cell lymphomas. B-cell lymphoma cases were further classified into low, intermediate, and high grade. These were 15 (6.6%) low-grade lymphomas, 4 (1.8%) Burkitt lymphomas, and 92 (40.3%) high-grade lymphomas. The full details of the NHL subtypes are presented in Table I.

HIV status of the lymphoma patients

There were 133 (58.33%) lymphoma patients who were HIV-positive, 23 (10.09%) were HIV-negative (one of whom had a heart transplant), and 72 (31.58%) were of unknown immune status. The median age of the HIV-positive patients at diagnosis was 41.03 years (range, 8-70 years), and 86 (64.66%) were men. Most HIV-positive patients presented with plasmablastic lymphomas (PBLs) ($n = 59$; 44.36%) and diffuse large B-cell lymphomas (DLBCLs) ($n = 63$; 47.36%).

$CD4^+$ cell count was available for 53 (39.85%) HIV-positive patients at diagnosis. The mean $CD4^+$ cell count was 246.94 cells/mm^3 (range, 6-979 cells/mm^3). Overall, lymphomas were found in patients with $CD4^+$ cell counts of <400 cells/mm^3, except for patients presenting with HL (Figure 1). HIV-positive patients with PBLs had the lowest median $CD4^+$ count of 147 cells/mm^3 (19-656). HIV RNA viral loads were available for only 23 (17.29%) patients and ranged from lower than detectable to 2,630,000 copies/mL. Only 74 (55.64%) HIV-positive patients were on ART; most of these had

Table I. Clinical characteristics of lymphoma patients stratified by HIV status

		HIV status		
		Pos N = *133*	*Neg* N = *23*	*P value*
Age at diagnosis in years	Median	42	54	.078
	Mean	41,1	48,2	
	Range	8-70	5-77	
Sex	Male	86 (64.7%)	16 (69.6%)	.208
	Female	47 (35.3%)	7 (30.4%)	
Lymphoma type	BL	1 (0.8%)	1 (4.3%)	<.001
	DLBCL, ABC	24 (18.0%)	3 (13.0%)	
	DLBCL, GC	11 (8.3%)	1 (4.3%)	
	DLBCL, NOS	28 (21.1%)	7 (30.4%)	
	HL	4 (3.0%)	3 (13%)	
	NKTCL	1 (0.8%)	0 (0.0%)	
	PBL	59 (44.4%)	2 (8.7%)	
	Plasma cell myeloma	3 (2.3%)	0 (0.0%)	
	Plasmacytoma	2 (1.5%)	0 (0.0%)	
	Small cell lymphoma	0 (0.0%)	6 (26.1%)	
Tumor site	Buccal mucosa	8 (6,1%)	1 (4,3%)	
	Floor of mouth	1 (0,8%)	0 (0,0%)	
	Gingiva, NOS	1 (0,8%)	0 (0,0%)	
	Larynx	1 (0,8%)	0 (0,0%)	
	Lip	2 (1,5%)	0 (0,0%)	
	Mandible	15 (11,5%)	1 (4,3%)	
	Maxilla	43 (32,8%)	2 (8,7%)	
	Nasopharynx, NOS	3 (2,3%)	0 (0,0%)	
	Neck, NOS	14 (10,7%)	5 (21,7%)	
	Oropharynx	11 (8,4%)	2 (8,7%)	
	Palate	5 (3,8%)	1 (4,3%)	
	Parotid region	9 (6,9%)	5 (21,7%)	
	Right tonsil	0 (0,0%)	1 (4,3%)	
	Sinonasal region	9 (6,9%)	1 (4,3%)	
	Submandibular	9 (6,9%)	3 (13,0%)	
	Submental	0 (0,0%)	1 (4,3%)	
EBV status	Negative	42 (36.5%)	16 (76.2%)	.001
	Positive	73 (63.5%)	5 (23.8%)	
$CD4^+$ cell count ($N = 53$)	Range (cells/mm^3)	6-979		
	Median	246.94		
	Mean	192		
	STD deviation	208.897		
HIV RNA viral load (copies/mL)	Range	LD to 2,630,000		
	Median	13,723		
	Mean	182,013.26		
	STD deviation	560,879.393		
HIV RNA viral load (copies/mL)	<1000	9 (6.9%)		
	1000-10,000	2 (1.5%)		
	>10,000	14 (10.7%)		
	Missing	108 (82%)		
ART (*N* = 96)	Naïve	20		
	Defaulted	2		
	On treatment	74		
Ann Arbor stage	I	5 (14.3%)	1 (8.3%)	.076
	II	7 (20.0%)	4 (33.3%)	
	III	8 (22.9%)	3 (25.0%)	
	IV	15 (42.9%)	4 (33.3%)	
Status at follow-up (dead/alive)	Died	35 (47.9%)	6 (31.6%)	.029
	Alive with disease	22 (30.1%)	12 (63.2%)	
	Lost to follow-up	16 (21.9%)	1 (5.3%)	

EBV, Epstein Barr virus; *BL*, Burkitt lymphoma; *DLBCL*, diffuse large B-cell lymphoma; *NOS*, not otherwise stated; *ABC*, activated B-cell type; *GC*, germinal center; *LD*, lower that detectable; *ART*, anti-retroviral therapy; *HL*, Hodgkin lymphoma; *NKTCL*, -NK/T-cell lymphoma.

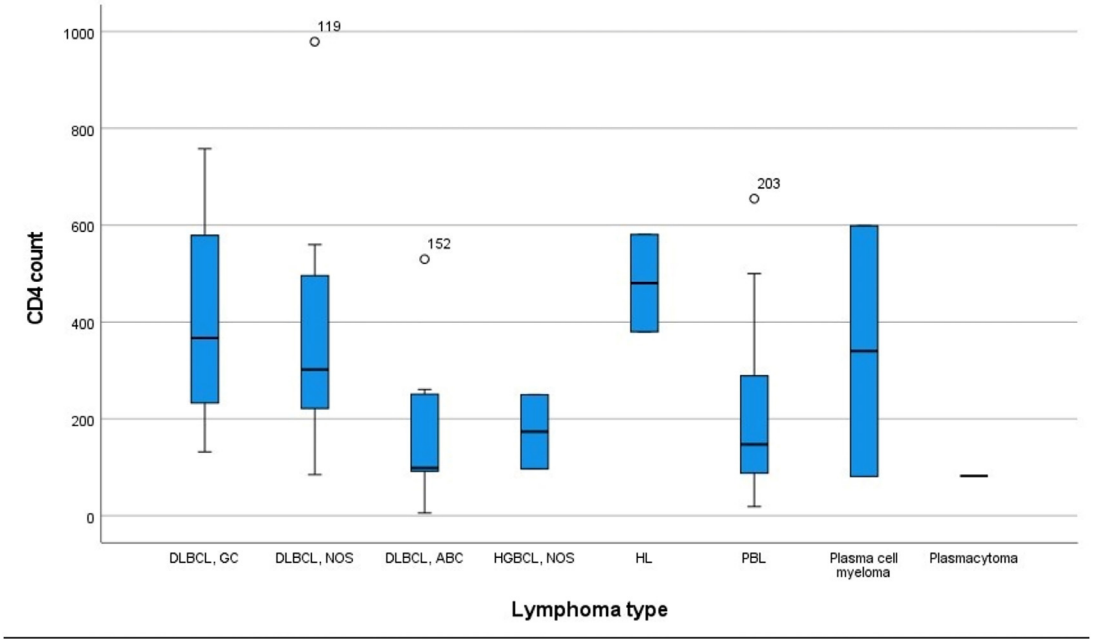

Fig. 1. Lymphomas in HIV-positive patients correlated by $CD4^+$ cell count.

PBLs (45.59%), while 2 (1.5%) had defaulted on ART, and 57 (42.86%) were ART naïve at diagnosis.

Epstein-Barr encoded RNA in situ hybridization (EBER-ISH) status of the lymphomas

A total of 190 (83.3%) cases had documented EBER-ISH status, of which 114 (60%) were EBER-ISH-positive, and 76 (40%) were EBER-ISH-negative. EBER-ISH positivity was significantly correlated with PBL (80/82), HL (6/9), natural killer/T-cell lymphoma, nasal type (2/2), and Burkitt lymphomas (4/4) ($P < .001$).

Correlation between HIV and EBV-ISH status in lymphomas

Seventy-three patients were positive for EBV, all of whom were HIV-positive. HIV-positivity was associated with EBER-ISH-positivity and lymphoma development (Pearson's chi-square; $P < .001$). PBL was the most common EBV-driven lymphoma in HIV-positive patients. There was no association between HIV-positivity and EBER-ISH-positivity in DLBCL patients (Table II).

Correlation between Ann Arbor clinical stage and lymphoma type

Ann Arbor staging was available for 50 (21.93%) patients, of which 7 (14%) were stage I, 12 (24%) were stage II, 12 (24%) were stage III, and 19 (38%) were stage IV. Lymphoma type was not associated with Ann Arbor stage (Pearson's chi-square, $P = .239$). No significant association was observed between low-stage (I, II) or high-stage (III, IV) Ann Arbor stage and lymphoma type (Pearson's chi-square, $P = .064$). Of the 50 patients, 35 were HIV-positive with 5 (14.2%) being stage I, 7 (20%) stage II, 8 (22.9%) stage III, and 15 (42.9%) stage IV. HIV-positive patients who presented at higher clinical stages had PBL. HIV-positive patients presented at a higher Ann Arbor clinical stage than the HIV-negative group, although this was not significant ($P = .075$).

Table II. Lymphoma in HIV-positive patients stratified by EBER-ISH status

Lymphoma type	*EBV status*			
	Unknown	*Negative*	*Positive*	*Total*
Burkitt lymphoma	0	0	1	1
Diffuse large B-cell lymphoma, ABC	1	18	5	24
Diffuse large B-cell lymphoma, GC	2	8	1	11
Diffuse large B-cell lymphoma, NOS	12	12	4	28
Hodgkin lymphoma	0	0	4	4
NK/T-cell lymphoma	0	0	1	1
Plasmablastic lymphoma	3	1	55	59
Plasma cell neoplasms	0	3	2	5
Total	18	42	73	133

ABC, activated B-cell; *GC*, germinal center; *NOS*, not otherwise specified; *NK/T-cell*, natural killer/T-cell.

Head and neck lymphoma patients on chemoradiation treatment

A total of 62/228 (27.19%) patients received treatment which included chemotherapy and radiation. Of these, 24 (38.7%) patients died while on treatment, 25 (40.32%) were alive at the last follow-up, and 13 (20.96%) patients were lost to follow-up. HIV-positive patients comprised 46 (74%) of all the patients on treatment.

Overall survival

Kaplan-Meier survival analysis was used to determine the OS of patients stratified by lymphoma type, HIV status, EBV status, and Ann-Arbor clinical stage. Follow-up data were available for 106/228 (46.49%) patients. The mean OS of the patients was 25.9 months (0-122, SDV 33.498). Forty (37.7%) patients were alive at the last follow-up, 18 were lost to follow-up, and 48 (45.3%) had died.

Overall survival of patients stratified by HIV status

Follow-up data were available for 73 (54.89%) HIV-positive patients and 19 (82.61%) HIV-negative patients. In the HIV-positive group, 38 (52.05%) patients were alive at the last follow-up, and 35 (47.95%) had died. Most of the HIV-positive patients who died had PBL and DLBCL. In the HIV-negative group, 13 (68.42%) were alive at the last follow-up, while 6 (31.58%) had died. The estimated mean OS was 58.73 months (95% CI, 38.93-78.54) and 57.23 months (95% CI, 42.67-71.79) in the HIV-negative and HIV-positive groups, respectively, which did not differ significantly (log-rank, P = .169). The OS for both groups was 60.97 (95% CI, 47.80-74.15) (Figure 2A).

Overall survival of the lymphoma patients stratified by EBER-ISH status

The mean OS in the EBER-ISH negative group was 60.14 months (95% CI, 41.76-78.52) and 59.95 months (95% CI, 42.55-77.35) in the EBER-ISH positive group, which did not differ significantly (log-rank, P = .511). The estimated OS for both groups was 62.99 months (95% CI, 49.62-35 months) (Figure 2B).

Overall survival of PBL and DLBCL in HIV-positive patients

The estimated mean OS was 61.56 months (95% CI, 40.95-82.17) and 45.77 months (95% CI, 23.67-67.86) in the DLBCL and PBL groups, respectively. The estimated OS for both groups was 54 months (95% CI, 438.75-69.35). There was no significant difference in OS between the PBL and DLBCL groups (log-rank, P = .665) (Figure 2C).

Overall survival of patients stratified by Ann Arbor stage

The estimated mean OS in the stage I group was 69.29 months (95% CI, 26.13-112.44), 72.06 months (95% CI, 48.02-96.09) in the stage II group, 26.89 months (95% CI, 13.41-40.36) in the stage III group, and 44.12 months (95% CI, 14.89-73.29) in the stage IV group, although no significant difference was noted (log-rank, P = .084). Patients in the lower staging group (I-II) had a better estimated mean OS (85.11 months) than those in the higher staging group (III-IV) (45.16 months), irrespective of age, sex, lymphoma type, EBER-ISH status, and HIV status; however, the OS of patients based on Ann-Arbor stage did not differ significantly (log-rank, P = .017) (Figure 2D).

DISCUSSION

Despite prevention campaigns and the introduction of ART in 2004, South Africa still has a high HIV infection rate and low ART coverage.[1] PLWHA are at an increased risk for lymphomas, which are often associated with EBV infection in the background of HIV immunosuppression.[5] In South Africa, a nationwide cohort study found that the most common hematolymphoid malignancies in PLWHA aged 15-24 years were HL and NHL, which were reported at 3.4 and 7.5 per 100,000 person-years, respectively.[14] The risk of developing hematolymphoid malignancies is associated with lower $CD4^+$ cell counts at baseline and being male.[4,14-17]

The most common lymphomas in our study were NHLs, including PBLs and DLBCLs. This is similar to what has been reported in the literature.[18-22] The most common site of lymphoma was the oral cavity, specifically the maxilla. However, the results are biased by the facility where the research was conducted, which was an oral health center. Lymphomas were associated with HIV immune suppression, middle age (35-60 years), and EBV infection, as indicated by EBER-ISH staining. Only 1 patient with PBL had a previous history of a heart transplant and had been on immunosuppressive therapy.

In HIV-positive patients, we found that lymphomas were predominantly noted in males with $CD4^+$ cell counts below 500 cells/mm^3. Lymphoma development in the background of HIV infection is associated with immunosuppression related to the loss of T-cell immune surveillance, especially in the immune control of EBV oncogenesis and chronic B-cell dysregulation.[23,24] Cumulative viremia is also associated with the risk of lymphoma development, independent of $CD4^+$ cell count.[4,25] The direct role of HIV in the development of lymphomas has also been suggested, through chronic B-lymphocyte activation and possibly contributing to malignant transformation.[26]

Only 17.23% of the patients had recorded viral loads; hence, we did not investigate the correlation between viral load and lymphomas.

PLWHA are reported to have a greater risk of developing NHL compared to the general population.[3] However, there are conflicting reports regarding the decline in the incidence of lymphoma with ART. The incidence of Burkitt lymphoma and Hodgkin lymphoma in HIV-positive patients on ART and patients with high $CD4^+$ cell counts has not declined.[15,24] Thus, immunosuppression alone may not be the sole driver of lymphoma development in PLWHA.

In this study, PBLs and DLBCLs were the most common NHL in the HIV-positive group, accounting for 44% and 47% of cases, respectively. PBL is a high-grade NHL with a predilection for the oral cavity and is commonly associated with HIV and EBV infections.[27] Our findings showed that HIV-positive patients with PBL were mostly men with a median $CD4^+$ cell count of 147 cells/mm^3 and advanced clinical stage.

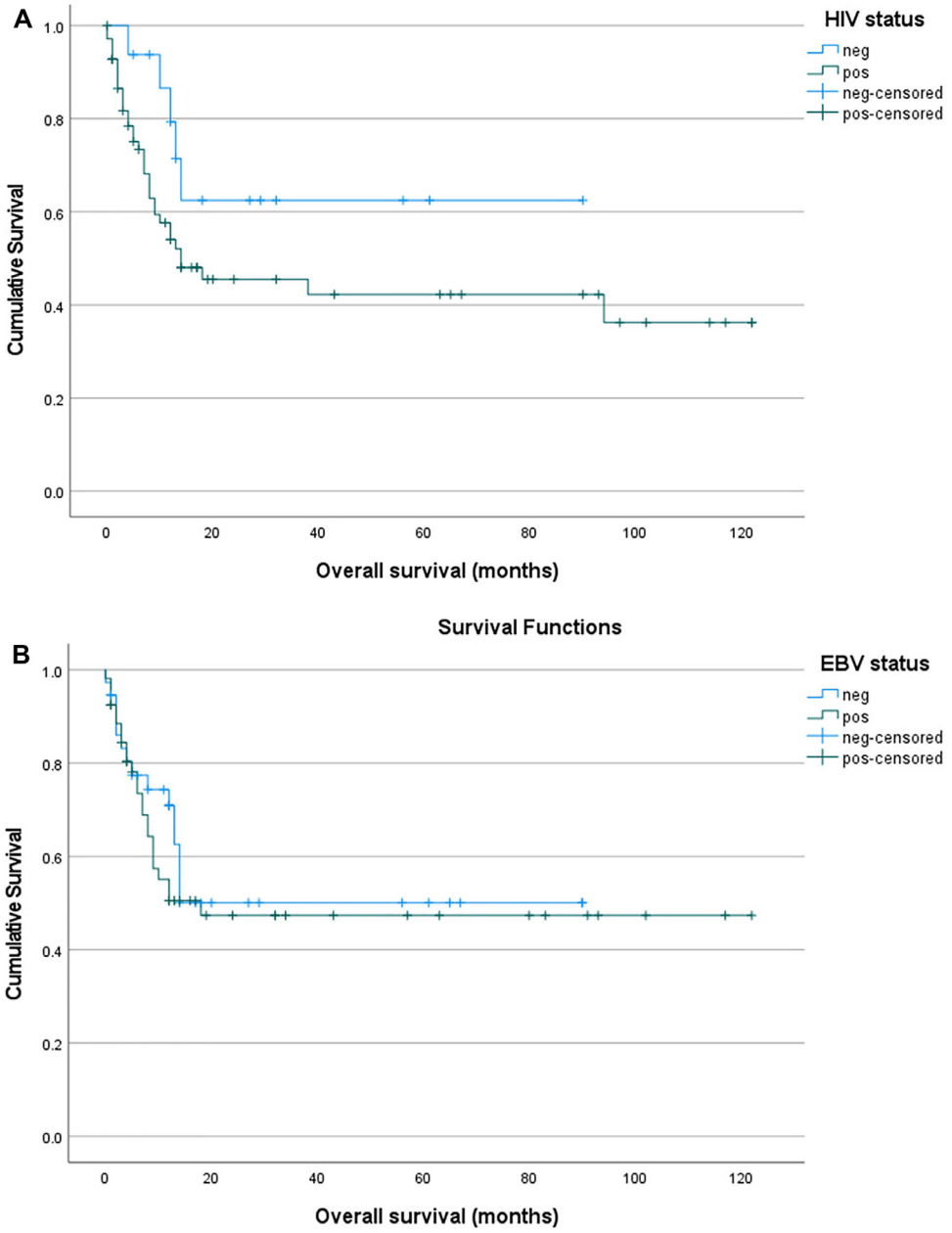

Fig. 2. Kaplan-Meier curves for estimated overall survival (OS) in lymphoma patients stratified by (A) HIV status, (B) EBV-ISH status, (C) lymphoma type, and (D) Ann Arbor staging.

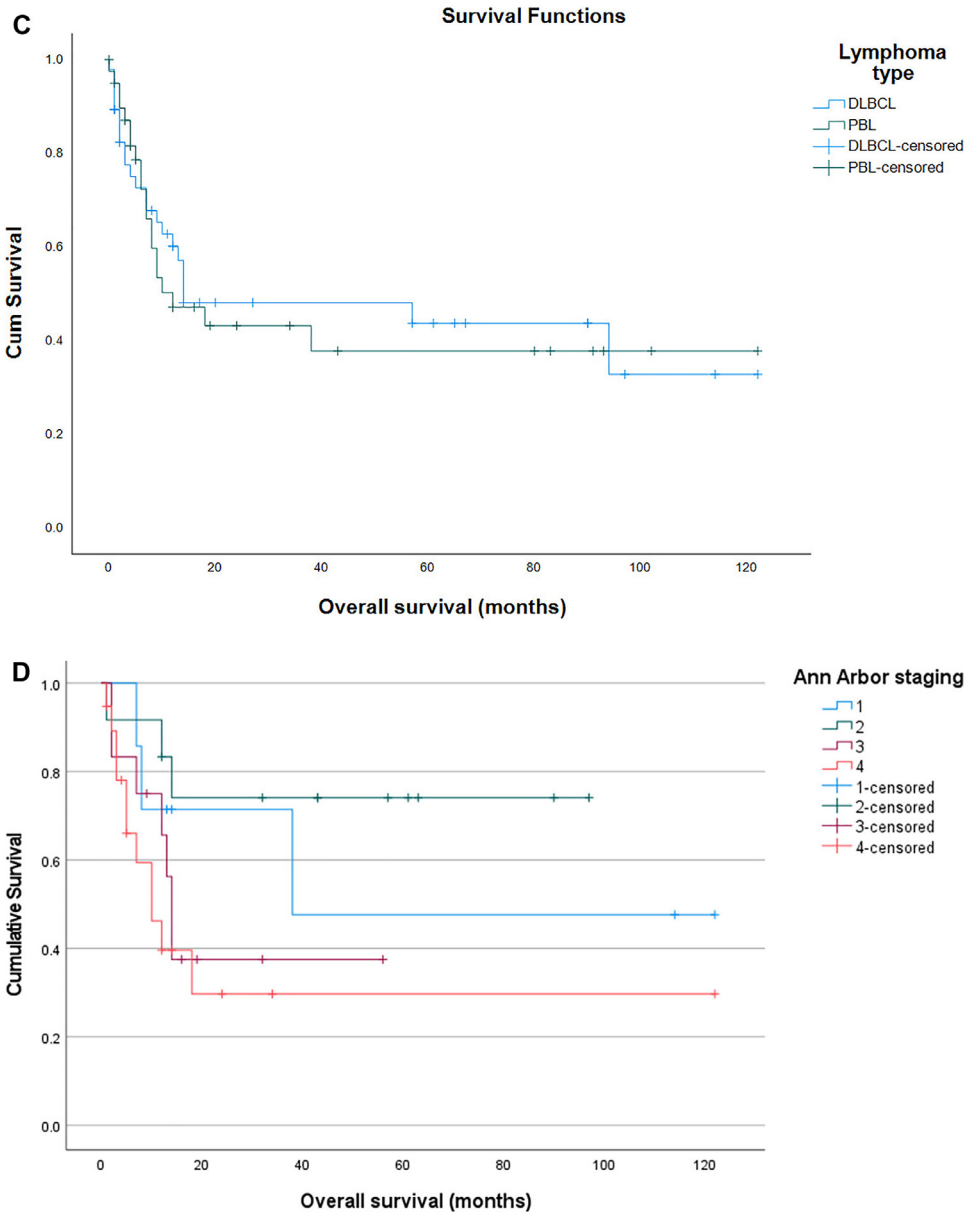

Fig. 2. Continued

Most patients with PBL were on ART at the time of lymphoma diagnosis; however, due to a lack of HIV viral load data, it was not possible to determine if they were virally suppressed. PBL has an aggressive clinical course and a low survival rate.[28] PLWHA with PBL have a reported median OS of 4-15 months.[27-29]

PBL is associated with a poor prognosis, irrespective of HIV status. The estimated mean OS of HIV-positive patients with PBL in our study was 45.765 months (median OS of 12 months). A systematic review by Castillo et al.[27] reported a median OS of 15 months for 112 HIV-associated PBL cases, with a 3-year survival rate of 25%. Similarly, HIV-negative patients with PBL had a reported median OS of 9 months, with a 2-year OS rate of 10%.[30] A review of 300 PBL cases by Morscio et al.[31] showed an OS of 8 months irrespective of HIV status, with an OS rate of 10 months in HIV-positive patients, 11 months in HIV-negative immunocompetent patients, and 7 months in post-transplant PBL patients. A similar poor survival outcome of 5 months was reported by Schommers et al.,[29] in a cohort of German patients with HIV-related PBL.

Alli and Meer[19] reported a high prevalence of PBL and DLBCL in the head and neck region; however, compared to our study, there was a varied association with HIV infection. PBL and DLBCL were noted in

56% vs. 44% and 39% vs. 47% of cases, respectively. The incidence of EBV co-infection in HIV individuals also varies. DLBCL is the most commonly reported NHL in the head and neck region, regardless of HIV or EBER-ISH positivity.[32-34] In our study, PBL and DLBCL were equally distributed among HIV-positive lymphoma patients. Gibson et al.[35] reported a high risk of NHL among PLWHA compared to the general population, with DLBCL being the more prevalent subtype, even in the era of highly active antiretroviral therapy. This study found that DLBCL was more common in HIV-positive patients than in HIV-negative patients. Contrary to our results, other studies in the South African population have reported an equal prevalence of DLBCL in HIV-positive and HIV-negative patients.[19,36] Although DLBCL cases in our study were strongly associated with HIV infection, these lymphomas showed an overall low EBER-ISH expression.

EBV co-infection was detected in 84% of HIV-positive lymphoma patients, of whom most had PBLs. This is in contrast to the low EBV positivity in HIV-positive lymphoma patients reported in the literature.[19,36,37] There are contrasting reports on the distribution of EBV in PLWHA with DLBCL.[36,38] A retrospective cohort study reported an equal distribution of DLBCL-germinal center and DLBCL-activated B-cell subtypes in both HIV-positive and HIV-negative patients, with EBV co-infection detected in 16% of HIV-positive patients compared to only 7% of HIV-negative patients.[36]

The prognosis of PLWHA with lymphomas has improved since the advent of HAART.[39,40] However, HIV infection cannot be solely used as a prognostic factor because other factors may affect the survival of patients with lymphoma, including age, sex, Ann Arbor stage, lymphoma type, and EBV co-infection. Patients >50 years with EBV-associated DLBCL not otherwise specified were reported to have shorter OS.[41] In contrast, our results showed that irrespective of HIV status, there was a marginal difference in the estimated mean OS of 59.95 and 60.138 months in the EBER-ISH-positive and EBER-ISH-negative groups, respectively. However, there was a strong association between EBV co-infection and PBL, and these patients had poor clinical outcomes.

Apart from PBL and DLBCL, clinicians should be vigilant for plasma cell neoplasms in PLWHA. Four patients in our study had plasma cell neoplasms, including 3 with plasma cell myeloma. All 4 patients were aged 42-49 years. The prevalence of multiple myeloma in PLWHA was reported at 21.48% in patients aged 40-50 years.[42] There are similar reports of multiple myelomas in young patients with HIV infection.[17,43] HIV patients with multiple myelomas were reported to have a higher $CD4^+$ T-cell count at baseline.[17,44] Our results for plasma cell neoplasms were skewed by low $CD4^+$ T-cell counts, with a median of 82 cells/mm^3 (range 81-599). To assess the true nature of plasma cell neoplasm in HIV infections, more cases should be documented.

There were several limitations to our study, the main one being the retrospective study design, which relied on documented clinical and laboratory information. There were patients with incomplete data on HIV status, ART status, EBV status and follow-up information. The retrospective design also affected the classification and diagnosis of lymphomas, which was based on the current WHO classification used at the time of diagnosis. Certain lymphomas have changed classification under the current WHO classification.[45] Lastly, EBV-ISH status is not routinely done on high-grade lymphomas; hence, this was not available for every lymphoma case.

CONCLUSION

Both PBL and DLBCL were the most common head and neck lymphomas in our study, and these were associated with HIV immune suppression, male sex, and middle age. Only PBL was strongly associated with EBV infection. Overall, these lymphomas were found in patients with $CD4^+$ T-cell counts of <400 cells/mm^3. Patients with HIV infection had a lower OS rate compared to HIV-negative patients. Most lymphoma patients were tested for HIV infection after the lymphoma diagnosis. Therefore, it is possible that the poor disease outcome in some of the patients was mainly due advanced HIV clinical stage rather than the aggressiveness of the lymphomas. Taken together, our results show that HIV infection increases the risk of head and neck PBL, and these lymphomas have a poor prognosis.

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PRESENTATION

This study was presented at the Faculty of Health Science Research Day at the University of Pretoria, South Africa, August 2023, and the South African Society of Maxillofacial and Oral Surgeons (SASMFOS) Congress on September 26-28, 2024, Johannesburg, South Africa. The study is for the dissertation entitled: The prevalence and clinical profile of head and neck Epstein-Barr virus-positive B-cell lymphomas in patients with HIV infection, which was submitted for the degree MChD (Maxillofacial and Oral Surgery) at the University of Pretoria, South Africa.

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ETHICAL STATEMENT

The study protocol and ethics were approved by the School of Dentistry Research Committee (RESCOM) and the Faculty of Health Sciences Research Ethics Committee (reference number: 692/2021).

DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, T. K. The data are not publicly available due to privacy or ethical restrictions.

DECLARATION OF INTERESTS

None.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Buntu Xoki: Writing – review & editing, Writing – original draft, Methodology, Investigation, Data curation, Conceptualization. **Andries Masenge:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation. **Tsholofelo Kungoane:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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