Role of Ultrasound in the Detection of Lesions of the Parotid Gland in HIV Patients

Ceena Denny E[1]*, Gajendra Veeraraghavan[2], Santosh Rai[3], Almas Binnal[2], Nikhil Victor Dsouza[4], Ramya Shenoy[5], Bastian TS[6]

1. Department of Oral Medicine and Radiology, Manipal College of Dental Sciences Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India.
2. 5 Tournville lodge, Rathfarnham, Dublin D14. Ireland.
3. Department of Radiology and Imaging, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India.
4. Department of Internal Medicine, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India.
5. Department of Community Dentistry, College of Dental Sciences, Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India.
6. Department of Oral and Maxillofacial Pathology, Mahe Institute of Dental sciences & Hospital, Chalakkara, Palloor, Mahé, Kerala.

Abstract

Salivary gland disease is common among human immunodeficiency virus-infected patients and is a major cause of morbidity among them. Hence this cross-sectional analytical study was done to assess the parotid gland changes in Human immunodeficiency virus-infected patients who were on highly active antiretroviral therapy using ultrasound.

A total of 137 Human immunodeficiency virus-infected patients who were on regular therapy for more than 1.5years were randomly selected for ultrasonographic examination of the parotid gland. The various sonographic patterns of the parotid glands were noted and compared with CD4 count, viral load, and the duration of therapy. Among the study participants sixty- two patients had normal parotid findings and the other four main sonographic findings were fatty infiltration, lymphadenopathy, lymphocytic aggregates, lymphoepithelial cyst in descending order. Incidental findings were hypoechoic areas, parotid abscess and necrotic lymph nodes. On comparing CD4 count with parotid changes among the various groups, most of the subjects were in stage I (CD4 COUNT>500) with a significant p-value (P=0.006).

The parotid changes when compared with the viral load it was noted that most of the subjects (79.6%) were in group II(undetectable) with a significant p-value(P=0.048). However, the p-value was found insignificant while comparing the duration of HAART and the parotid changes.

Hence, ultrasound, a non-invasive imaging modality is gaining popularity by reducing the surgical intervention in both detection and diagnosis of soft tissue abnormalities of the parotid gland in asymptomatic HIV patients with no clinically evident lesions.

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Introduction

Human Immunodeficiency Virus (HIV) highly prevalent infectious disease was discovered in the early 1980s and has caused more than 20 million deaths.[1] According to Joint United Nations Programme on HIV/AIDS (UNAIDS) around 17,000,00 new cases and 6,90,000 deaths were reported in 2019.[2] It was found that around 23.49 lakh people are living with HIV in India with 69.22 thousand newly diagnosed cases in 2019. In Karnataka 2.69 lakh people are living with HIV and it was found that there was a 75% decline in newly diagnosed cases with a 9.72% mortality rate.[3]

Around 56% of people living with HIV (PLHIV)/AIDS are on antiretroviral treatment (ART) in India,[4] hence, the life span has increased in these people since the advent of

*Corresponding author:
Professor, Dr. Ramya Shenoy MDS
Incharge HOD, Department of Community Dentistry,
Manipal College of Dental Sciences Mangalore
Manipal Academy of Higher Education, Manipal,
Karnataka, India-575001
E-mail id:ramya.shenoy@manipal.edu

HAART which is a combination of three drugs.

Although the pathognomic oral manifestations in HIV have declined tremendously due to the early initiation of HAART, there is an increased prevalence of HIV-related salivary gland diseases(SGD).[5] SGD act as an important diagnostic and prognostic indicator in HIV infection. There are chances of lymphoepithelial cysts even though benign in nature can develop into malignant lymphoma in later stages. Hence periodic examination is necessary.[6]

Ultrasound, a non-invasive imaging modality that reduces the surgical intervention is gaining popularity in diagnosing soft tissue swellings in the oro-facial region. Early detection of parotid gland diseases and periodic monitoring of patients with HIV can avert the risk of developing neoplasms. This could cause a debilitating condition in each patient which can also have an effect on oral health and quality of life due to disfigurement of the facial structure. Interdisciplinary research is gaining momentum both in the diagnosis and treatment of HIV infection and its manifestations. Therefore, this study was done to assess the various parotid gland changes in HIV- positive patients using ultrasonography and to compare it with CD4 counts and viral loads and duration of HAART.

Materials and methods

This was a cross-sectional analytical study carried out in a tertiary-care center in Karnataka. The research protocol was approved by the institutional research ethics committee (Protocol reference no.20036). A total of 137 patients who were confirmed positive by blood tests and who came regularly for treatment and counseling were recruited from the ART (Antiretroviral Therapy) center from January to March 2021 were randomly selected. The need for this study was explained to the subjects. The participant information sheet was provided to individual subjects once they agreed to join the study. The PI (principal investigator) entered the details in the information sheet. The patient's demographic, socioeconomic, and health-related information were obtained through a structured questionnaire. The eligible patients were those People Living with HIV/AIDS (PLWHA) and undergoing treatment for a minimum of 1.5years. This limit was chosen as it provides more valuable information on viral load testing.[7] The subjects who were not cooperative, were very ill and could not be mobilized were excluded from the study. The data regarding the patient's CD4 count, viral load values and HAART details were obtained from the ART records. Care was taken to maintain the anonymity of the patients.

Patients were then subjected to ultrasonographic examination of the parotid salivary glands. The ultrasonographic investigations were carried out at the Department of Radiology using a high-resolution probe with a frequency between 7-12 Mhz ("Voluson expert" GE Healthcare, USA). All the examinations were carried out by an expert medical sonologist. A detailed examination of the parotid gland was done to visualize any changes. The ultrasound transducer was placed over the skin perpendicular to the parotid gland with minimal pressure in all planes on either side of the face. The sonographic patterns of the parotid were recorded based on the classification done by C Kabenge et al (2010).[8] Once the examination was done the observations were compared with their CD4 counts, viral load and duration of HAART. Subjects were categorized into stages in accordance with CDC classification depending upon their CD4 T-cell count into three stages (Stage I (>500), Stage II (200-499), Stage III <200)).[9]

The viral load of the subjects was assessed and grouped into three groups (suppressed, undetectable, and high viral load).[10] The HAART therapy regimens were classified (first, second and third-line regimens) according to WHO interim guidelines 2018.[11]

Assuming the association as 30% to Salivary gland changes in HIV patients on HAART, at 95% confidence interval and 80% power the sample to be assessed for the present study was 137. The sample size was calculated using G*Power 3.1.9.4. Statistical analysis was carried out using SPSS (17.0) version (IBM SPSS® Statistics) -Java(TM) Platform SE binary-IBM Corp: London: UK. The descriptive statistics were tabulated. Chi-square was applied to check the association between the groups to parotid changes. The binary logistic regression with the dependent variable as presence or absence of abnormal parotid findings in HIV patients was carried out. The p-value was kept at ≤ 0.05 to assess the statistical significance.

Results

During the study period, 137 HIV patients were included and among them 83 were males and 54 were females. The youngest patient was 18 years and the oldest was 77 years with a mean age of 44.77±9.61. The demographic details and habit history of the participants are summarized in Table 1.

Age	Total (137)
18-28	9(6.6%)
29-38	24(17.5%)
39-48	57(41.6%)
49-58	40(29.2%)
59-68	6(4.4%)
69-78	1(0.7%)
Gender	
Male	83(60.6%)
Female	54(39.4%)
Education	
Illiterate or Primary School	82(59.9%)
High school or Intermediate	34(24.8%)
Graduate or Post Graduate	9(6.6%)
Professional or Honors	12(8.8%)
Occupation	
Unemployed	10(7.3%)
Semiskilled	25(18.2%)
Skilled	72(52.6%)
Professional	30(21.9%)
Habit history	
No habit history	85(62%)
Smoking tobacco	10(7.3%)
Smokeless tobacco	6(4.4%)
Alcohol consumption	21(15.3%
Smoking and alcohol consumption	11(8%)
Smokeless tobacco and alcohol consumption	4(2.9%)

Table 1. The baseline details of the HIV patients.

Among the 137 patient's majority had no associated comorbidities, while a few had tuberculosis(n=14). Most participants who were enrolled in this study were in stage I according to WHO staging (n=91). Sixty-four patients had a CD4 cell count above 500 and twenty-four patients had a CD4 cell count below 200. The viral load was undetectable in 79.6% of patients. One twenty-four patients were in the first- line of therapy and the rest were in the second-line regimen. The majority of the patients were on HAART for more than 8 years with a mean duration of 6.79±2.94 years. (Table 2)

WHO STAGING	No. of patients(%)
I	91(66.4%)
II	8(5.8%)
III	15(10.9%)
IV	23(16.8%)
CD4 COUNT	
Stage I (>500)	64(46.7%)
Stage II(200-499)	49(35.8%)
Stage III(<200)	24(17.5%)
VIRAL LOAD	
Suppressed/not suppressed (where ≤200 copies/mL is suppressed and >200 copies/mL is not suppressed	24(17.5%)
Undetectable VL (≤50 copies/mL))	109(79.6%)
High VL (>100,000 copies/mL)	4(2.9%)
HAART THERAPY	
1st line of therapy	121(88.3%)
2nd line of therapy	16(11.7%)
3rd line of therapy	Nil
DURATION OF HAART	
Less than 4 years	29(21.2%)
4-8 years	52(38%)
More than 8 years	56(40.9%)

Table 2. Depicts HIV patients categorized according to the diagnosis and treatment modality.

	Normal	Abnormal
CD4 count		
Stage 1	24(38.7%)	38(61.3%)
Stage II	20(39.2%)	31(60.8%)
Stage III	18(75%)	6(25%)
Chi-square value, df,p value	10.39,2,0.006	
VIRAL LOAD		
Group 1	25(59.5%)	17(40.5%)
Group 2	34(41%)	49(59%)
Group 3	3(25%)	9(75%)
Chi-square value, df,p value	6.05,2,0.048	
HAART THERAPY		
Group 1	12(41.4%)	17(58.6%)
Group 2	24(46.2%)	28(53.8%)
Group 3	26(46.4%)	30(53.6%)
Chi-square value, df,p value	0.244,2,0.89	

Table 3. Comparison of the parotid gland changes in different CD4 count stages,viral load and HAART therapy grouping among HIV patients.

According to Table 3, sixty- two (45.3%) study subjects had normal parotid findings and the other four main sonographic findings were fatty infiltration (n=33)(Fig1a) followed by lymphadenopathy (n=15)(Fig 1b), lymphocytic aggregates (n=11), lymphoepithelial cyst (n=10)(Fig1c). Incidental findings were hypoechoic areas (n=5) (Fig 1d), parotid abscess and necrotic lymph node (n=1).

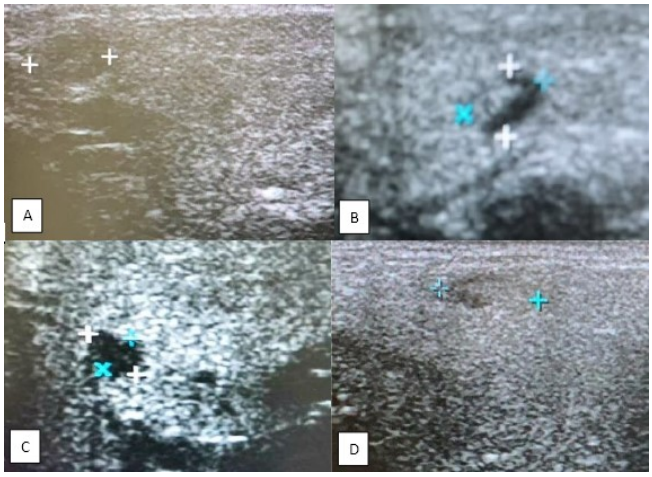

Figure 1. Various sonographic changes in the parotid gland. 1A.Fatty infiltration. 1B. Lymphadenopathy. 1C. Lymphoepithelial cyst. 1D. Hypoechoic areas.

In comparing CD4 count with parotid findings most of the subjects were in group I (CD4 >500) and we had fewer patients in group III (CD4< 200) with a significant p-value (P=0.006). Parotid changes when compared with the viral load, it was noted that most of the subjects were in group II i.e., the viral load was undetectable (n=109(79.6%) with a significant p-value(P=0.048). The p-value was insignificant on comparing the duration of HAART and the parotid changes(P=0.89). (Table 4).

Ultrasound patterns	No. of patients(%)
Normal Parotid Glands	62(45.3%)
Lymphocytic Aggregates	11(8%)
Lymphoepithelial Cyst	10(7.3%)
Fatty Infiltration	33(24.1%)
Lymphadenopathy	15(10.9%)
Necrotic Lymphnode	1(0.7%)
Hypoechoic Area	5(3.6%)
Parotid Abscess	1(0.7%)

Table 4. Types of sonographic patterns and their prevalence.

	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Gender	.593	.401	2.189	1	.139	1.810	.825	3.972
CD4			9.826	2	.007			
CD4(1)	1.739	.565	9.462	1	.002	5.694	1.880	17.247
CD4(2)	1.519	.567	7.179	1	.007	4.567	1.504	13.875
Viral Load			6.714	2	.035			
Viral Load(1)	-1.765	.820	4.641	1	.031	.171	.034	.853
Viral Load(2)	-.862	.770	1.253	1	.263	.422	.093	1.911
HAART Therapy	-.038	.421	.008	1	.928	.963	.422	2.199
Constant	-.386	1.175	.108	1	.743	.680		

Table 5. Binary logistic regression based on presence of normal and abnormal parotid findings of the patients as dependent variable.

While comparing the parotid on both sides many subjects had unilateral intraparotid nodes less than 6mm (n=17), more than 6mm(n=8), unilateral cyst (n=4), bilaterally intraparotid lymph nodes less than 6mm(n=6), bilateral cyst(n=3).Table 5

The binary logistic regression with dependant variables such as the presence or absence of abnormal oral findings in HIV patients showed a statistically significant relation to CD4 count and viral load. But there was no statistically significant relationship between gender and systemic diseases. (Table 5)

Discussion

Our study shows that ultrasonography is ideal for evaluating soft tissue structures like the parotid gland. The other advantages of this imaging modality are easy to access, inexpensive, painless and do not use radiation.[12] The sonographic patterns of the parotid were done based on the classification done by C Kabenge et al (2010).[8]

Various studies have been reported on the prevalence of salivary gland diseases, few studies showed a high prevalence of SGD,[13] whereas Basu D et al (2006)[14] in his study found that there was a decrease in SGD and Panayiotakopoulos GD et al (2003)[15]in their study found no SGD in study subjects.

Among the seventy-five patients diagnosed with pathology thirty- three had fatty infiltration in the parotid gland and most of these patients were on HAART for more than 8 years. This could be due to the effect of HAART and it is also being noted that fatty infiltration could be a side effect of protease inhibitors according to C Kabenge et. al 2010.[8]

Various reasons cited for fatty infiltration are hypertriglyceridemia, Sjogren's syndrome, whereas in diabetics and alcoholics it was found that there was a reduction in fat tissue of stroma.[16]

The presence of lymphoid tissue is found inside the capsule of the parotid while it lies outside or adjacent with regards to the submandibular gland.[17] In our study we found diffuse small hypoechoic areas which were less than 5mm in size with a mild heterogeneous texture of parotids. Kabenge C. et.al (2010) in their study reported that even though many authors said lymphoepithelial cysts and

lymphocytic aggregations appeared similar they found that there was a difference in size. They found that the lymphocytic aggregates were smaller in size(<5mm) when compared to lymphoepithelial cysts.Salivary gland lymphadenopathies exclusively associated with HIV infection were first reported in 1985. Parotid gland lymphadenopathy either present unilaterally or bilaterally could be the initial symptom of HIV infection.[18]

Parotid lymphadenopathy in HIV- infected patients could be due to follicular hyperplasia of the lymphoid tissue which could be visible clinically or it could be associated with opportunistic infections or neoplasia.[19] It was seen that the intranodal lymphoid hyperplasia which causes swelling can resemble salivary gland tumors.

A benign lymphoepithelial cyst (BLEC) even though a rare entity could be the initial manifestation of the infection.[20] The exact pathology even though remains unclear has been explained in two hypotheses. BLEC could develop due to entrapment of the parotid glandular epithelium in the normal intraparotid lymph nodes during the gland embryogenesis or the cyst could arise due to migration of HIV infected cells into the parotid gland which could cause ductal obstruction due to lymphoid proliferation and dysplasia of the salivary duct.[6,21-22] It can present unilaterally or bilaterally and either present as single or multiple cysts in the parotid gland.[23]

Kabenge et al (2010)[8] in their study found that 42% of patients had BLEC, he had also reported that few studies published had recorded a decreased prevalence (6–10%) of BLEC which was similar to our study. In our study, only 7.3% of the patients were diagnosed with BLEC. This reduction in the number of cases could be due to HAART which is in accordance with Meer S (2019)[5], in his review article, he also mentions that there could be an increase in BLEC due to the o increased survival rate in HIV patients on HAART. CT, MRI and ultrasound were the imaging modalities used in the diagnosis of BLEC. These cysts although usually benign in nature have a chance to turn into lymphomas. These lesions which are easily diagnosed by ultrasound should be evaluated periodically.[24]

Close monitoring of the lesion is the mainstay other treatment modalities include HAART, sclerosing therapy, radiotherapy and surgery.[23]

Among the 137 cases, 5 had echogenic foci which were lesser than 4mm in size which according to Kabenge et.al (2010)[8] could be microcalcifications. Dave et al. found multiple tiny radiopaque dots on CT images of the gland and had also interpreted them as microcalcifications.[23]

Olsen WL et. al (1988)[24] found necrotic nodes on CT scan of an HIV patient but could not appreciate it on MRI as the nodes were of homogenous high signal on T2 weighted MRI scan.[25]

CD4 cell count is raised since the advent of HAART. Most of the patients had CD4 cell count above 500 this could be because all the patients were on HAART and they were on regular follow-up.

Viral load monitoring helps us in identifying treatment failure and helps us in avoidance of drug resistance.[26] Increase in the viral load serves as a clinical marker of deterioration of the immune system and also the progression of the disease.[27] The viral load shows how active the virus is in the system. Sometimes the viral load is reduced to levels such that they cannot be detected by standard laboratory tests in patients on antiretroviral therapy.[28] In our study majority of the patients the viral load was undetectable (79.6%). This could be due to all patients being on HAART and adhering to the treatment without fail. Mandel L and Surattanont F (2002)[29] reported cases where there was a decrease in the parotid swelling after antiviral therapy and explained that it could be because of a decrease in the viral load leading to immune restoration. The viral load is tested initially every 6 months and then if the load is < 1000 copies/ml the test is done annually and if it is >1000 copies/ml the test is repeated after 3-6 months as it also determines whether the subject has to switch the treatment from the first regimen of therapy to the second or third regimen.[30]

According to WHO guidelines, a viral load of>5000 copies/mL denotes treatment failure for patients on HAART.[31] Routine viral load testing should be conducted at 6 and 12 months after ART initiation and every 12 months thereafter.

In our study, the patients (88.3%) were mostly on first-line of HAART therapy and only 11.7% were on second-line of therapy. In India, according to NACO guidelines, PI-based therapy is given only when the first regimen of drugs

doesn't respond, which was similar to our study.[32]

Conclusions

The use of Ultrasound for diagnosing soft tissue pathologies has been proven as a superior imaging modality as it is easily available, non-invasive, inexpensive, reduced scanning time. Early detection of pathologies in people without any symptoms can improve their overall well-being thus improving the quality of life in HIV/AIDS infected subjects.

Declaration of Interest

The authors report no conflict of interest.

References

1.Devyani Bahl, Mranali K Shetty, Karthik Shetty. HIV and AIDS Knowledge and Awareness among Dental Students in Mangalore, India: A Cross-Sectional Survey. J Int Dent Med Res 2020; 13(4): 1355-13581.
2. Joint United Nations Programme on HIV/AIDS (UNAIDS). UNAIDS Data 2020. Geneva: UNAIDS; 2020.
3.National AIDS Control Organization & ICMR-National Institute of Medical Statistics (2020). India HIV Estimates 2019: Report. New Delhi: NACO, Ministry of Health and Family Welfare, Government of India.
3.UNAIDS (2018) 'AIDS Data2018', p.140-141
5. Meer S. Human immunodeficiency virus and salivary gland pathology: an update. Oral Surg Oral Med Oral Pathol Oral Radiol. 2019;128(1):52-59. doi:10.1016/j.oooo.2019.01.001
6. Shivhare P, Shankarnarayan L, Jambunath U, Basavaraju SM. Benign lymphoepithelial cysts of parotid and submandibular glands in a HIV-positive patient. J Oral Maxillofac Pathol. 2015;19(1):107. doi:10.4103/0973-029X.157213
7. Awungafac G, Amin ET, Fualefac A, et al. Viral load testing and the use of test results for clinical decision making for HIV treatment in Cameroon: An insight into the clinic-laboratory interface. PLoS One.2018;13(6):e0198686. Published 2018 Jun 11. doi:10.1371/journal.pone.0198686
8. Kabenge C, Ng S, Muyinda Z, Ameda F. Diagnostic ultrasound patterns of parotid glands in human immunodeficiency virus-positive patients in Mulago, Uganda. Dentomaxillofac Radiol. 2010;39(7):389-399. doi:10.1259/dmfr/23992216
9. Vajpayee M, Kaushik S, Sreenivas V, Wig N, Seth P. CDC staging based on absolute CD4 count and CD4 percentage in an HIV-1-infected Indian population: treatment implications. Clin Exp Immunol. 2005;141(3):485-490. doi:10.1111/j.1365-2249.2005.02857.x
10.Centers for Disease Control and Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Division of HIV/AIDS Prevention, HIV Incidence and Case Surveillance Branch.(Centers for Disease Control and Prevention (US), National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. NCHHSTP strategic plan 2010–2015. February 2010 [cited 2013 Jul 27] Available from: URL: http://www.cdc.gov/nchhstp/docs/10_NCHHSTP-strategicPlanBookSemi-final508.pdf.)
11. World Health Organization. (2018). Policy brief: updated recommendations on first-line and second-line antiretroviral regimens and post-exposure prophylaxis and recommendations on early infant diagnosis of HIV: HIV treatment, interim guidance. World Health Organization. https://apps.who.int/iris/handle/10665/273632. License: CC BY-NC-SA 3.0 IGO
12. Ebrahim S, Singh B, Ramklass SS. HIV-associated salivary gland enlargement: a clinical review. SADJ. 2014;69(9):400-403.
13. Patton LL, McKaig R, Strauss R, Rogers D, Eron JJ Jr. Changing prevalence of oral manifestations of human immunodeficiency virus in the era of protease inhibitor therapy. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2000;89(3):299-304. doi:10.1016/s1079-2104(00)70092-8
14. Basu D, Williams FM, Ahn CW, Reveille JD. Changing spectrum of the diffuse infiltrative lymphocytosis syndrome. Arthritis Rheum. 2006;55(3):466-472. doi:10.1002/art.21980
15. Panayiotakopoulos GD, Aroni K, Kyriaki D, et al. Paucity of Sjogren-like syndrome in a cohort of HIV-1-positive patients in the HAART era. Part II. Rheumatology (Oxford). 2003;42(10):1164-1167. doi:10.1093/rheumatology/keg316
16. Garcia DS, Bussoloti Filho I. Fat deposition of parotid glands. Braz J Otorhinolaryngol. 2013;79(2):173-176. doi:10.5935/1808-8694.20130031
17. Tiwari A, Kini H, Pai RR, Rau AR. HIV lymphadenitis of the salivary gland: A case with cytological and histological correlation. J Cytol 2009;26:146-8
18.Ioachim HL. Lymphoid hyperplasias and lymphomas of salivary glands. *Pathol Case Rev.* 2004; 9:206–13.
19. Bem C, Barucha H, Patil PS. Parotid disease and human immunodeficiency virus infection in Zambia. Br J Surg. 1992;79(8):768-770. doi:10.1002/bjs.1800790818
20. Sekikawa Y, Hongo I. HIV-associated benign lymphoepithelial cysts of the parotid glands confirmed by HIV-1 p24 antigen immunostaining. BMJ Case Rep. 2017;2017:bcr2017221869. Published 2017 Sep 28. doi:10.1136/bcr-2017-221869
21. Bernier JL, Bhaskar SN. Lymphoepithelial lesions of salivary glands; histogenesis and classification based on 186 cases. Cancer. 1958;11(6):1156-1179. doi:10.1002/1097-0142(195811/12)11:6<1156:aid-cncr2820110611>3.0.co;2-2
22. Steehler MK, Steehler MW, Davison SP. Benign lymphoepithelial cysts of the parotid: long-term surgical results. HIV AIDS (Auckl). 2012; 4:81-6. doi: 10.2147/HIV.S27755. Epub 2012 May 28. PMID: 22719215; PMCID: PMC3377388.
23. Dave SP, Pernas FG, Roy S. The benign lymphoepithelial cyst and a classification system for lymphocytic parotid gland enlargement in the pediatric HIV population. Laryngoscope. 2007;117(1):106-113. doi:10.1097/01.mlg.0000246196.35413.35
24. Sharma G, Nagpal A. Salivary gland disease in human immunodeficiency virus/acquired immunodeficiency syndrome: A review. World J Dermatol 2015; 4(1): 57-62
25. Olsen WL, Jeffrey RB Jr, Sooy CD, Lynch MA, Dillon WP. Lesions of the head and neck in patients with AIDS: CT and MR findings. AJR Am J Roentgenol. 1988;151(4):785-790. doi:10.2214/ajr.151.4.785
26. Oliveira R, Krauss M, Essama-Bibi S, et al. Viral load predicts new world health organization stage 3 and 4 events in HIV-infected children receiving highly active antiretroviral therapy, independent of CD4 T lymphocyte value. Clin Infect Dis. 2010;51(11):1325-1333. doi:10.1086/657119
27. Jeffers L, Webster-Cyriaque JY. Viruses and salivary gland disease (SGD): lessons from HIV SGD. Adv Dent Res. 2011;23(1):79-83. doi:10.1177/0022034510396882
28.UNAIDS 2018 undetectable=untransmittable. Public health and HIV viral load suppression.
29. Mandel L, Surattanont F. Regression of HIV parotid swellings after antiviral therapy: case reports with computed tomographic scan evidence. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2002;94(4):454-459. doi:10.1067/moe.2002.126025
30.WHO. What's new in treatment monitoring: Viral load and CD4 cell testing, July 2017. Geneva: World Health Organisation; 2017. WHO/HIV/2017.22
31.World Health Organization. Antiretroviral therapy for HIV infection in children: towards universal access—recommendations for a public health approach, 2010 revision. 2010. http://www.who.int/hiv/pub/ paediatric/infants2010/en/index.html. Accessed 23 July 2010.
32.Kumar J V, Baghirath P V, Naishadham P P, Suneetha S, Suneetha L, Sreedevi P. Relationship of long-term highly active antiretroviral therapy on salivary flow rate and CD4 Count among HIV-infected patients. J Oral Maxillofac Pathol 2015;19:58-63.