



Assessing Oral Health Deterioration in Chronic Myeloid Leukemia Patients: A Comparative Study

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Abstract

Aim of the study: The current study aimed to determine the effects of chronic myeloid leukemia on oral health status and the presence of oral lesions in a group of Iraqi patients compared to healthy controls.

Material and method: The total sample consisted of 60 individuals, (30) were diagnosed with CML and (30) were healthy controls. Clinical examinations were carried out according to WHO oral health surveys. The scoring of dental plaque was according to plaque index criteria of Silness and Løe (1964), dental calculus was scored using Ramfjord's calculus index criteria (1959), the scoring of gingival status was according to gingival index criteria of Loe and Silness (1963), probing pocket depth and clinical attachment loss were scored according to WHO oral health survey (2013) and oral lesions examination was including inspection of intra-oral soft tissues. A mouth mirror and CPI probe were used in clinical examinations.

Results: The plaque index was higher in CML group than the control group with statistically significant difference between the two groups ($p < 0.05$). Gingival index, probing pocket depth, and clinical attachment loss were higher in the CML group as compared to healthy individuals and the difference was highly significant between two groups ($p \leq 0.01$). Although the calculus index was higher in the CML group, the difference was not statistically significant ($p > 0.05$). Conclusion: Patients with chronic myeloid leukemia presented inferior oral health and higher susceptibility for oral lesions compared to healthy individuals.

Conclusion: Patients with chronic myeloid leukemia exhibited worse oral health conditions and more oral lesions compared to healthy individuals.

Keywords: chronic myeloid leukemia, Clinical attachment loss, Dental plaque, gingival index, Oral lesions, petechiae, probing pocket depth.

Introduction

Leukemia is a form of cancer-related disease that occurs at different ages, including childhood and adulthood, and it is an important cause of death worldwide. Leukemia is related to leukocytes, which is associated with a rise in immature cells causing damage to both bone marrow and blood (Bukhari et al., 2022).

There are acute and chronic leukemias; acute leukemia is a fast growing type while chronic leukemia is slow growing type of leukemia. Additionally, each type can be subcategorized according to which kind of blood cell is affected into myeloid and lymphoid, so there are four types of leukemia: acute myeloid leukemia, acute lymphocytic leukemia, chronic myeloid leukemia and chronic lymphocytic leukemia (Ratley, Minj and Patre, 2020).



Chronic myeloid leukemia (CML) is a hematopoietic stem cell disorder of myeloid origin, and this type of leukemia occurs mostly in adult population. CML course includes three phases with different symptoms: chronic, accelerated, and blast phase (Rinaldi and Winston, 2023). CML is caused by single genetic abnormality, the Philadelphia chromosome (Ph) (Suttorp et al., 2021).

The oral cavity may reflect early clinical manifestations of (CML). The main affected oral tissues are buccal mucosa, gingival tissues, hard or soft palate and floor of mouth. Teeth mobility may occur when hard tissues are affected. Patients can present lesions, as oral ulceration, bleeding, ecchymosis, petechiae, bluish color or paleness in mucosa and areas of tissue necrosis (Quispe et al., 2022). The reasons of the oral manifestations in patients with (CML) are the infiltration of blasts of leukemic cells into gingiva this leads to thickness in gingival tissues and pseudo pockets formations, so those patients have enlarged and bleeding gingival tissue or these manifestations occur secondary to thrombocytopenia and poor function of granulocytes (Francisconi et al., 2016).

The purpose of this study was to evaluate (CML) effects on oral health situations, including dental plaque, dental calculus, gingival health status, loss of attachment and probing pocket depth, examine whether there are lesions in the oral cavity of those patients and compare the results with healthy controls.

Materials and Methodologies

The work of this study was performed during a time extended from February 2024

till the end of May 2024. The Ethics committee, College of Dentistry, Al-Mustansiriyah University provided approval for this protocol (no. 145, on 1 Dec 2023). In this study, the total sample consisted of 60 subjects, divided into two groups; study group consisted of 30 CML patients, and control group consisted of 30 subjects; they were both males and females, aged 40-50 years. They were examined in Hematology Teaching Center in Medical City and in National Center for Hematology Research and Treatment in Baghdad.

The inclusion criteria involved were:-

- Individuals were already diagnosed with chronic myeloid leukemia.
- Individuals were free from any other systemic diseases.
- Cooperative individuals.

Oral health examination and assessment were performed according to oral health surveys of WHO (WHO, 1997). The examiner passed inter and intra calibration procedures.

Dental plaque estimation was performed in this study by using plaque index criteria of Silness and Løe (1964) (Silness and Loe, 1964). The six index teeth are (16, 12, 24, 36, 32 and 44). The examination started from buccal surface through mesial and lingual surfaces ending at the distal surface.

Dental calculus estimation was performed by using the calculus index (C_{all}) criteria of Ramfjord (1959) (Ramfjord, 1959). The six "Ramfjord index teeth" used were: (16, 21, 24, 36, 41 and 44). The examination included facial and lingual surfaces of index teeth.

Gingival health status was calculated following gingival index (GI) criteria of Loe

and Silness (1963). The examination included the same index teeth that used in plaque index.

Probing pocket depth (PPD) was scored according to WHO oral health survey (2013) (WHO, 2013). All the present teeth were examined using a community periodontal index probe (CPI probe).

Loss of attachment was measured by dividing mouth in sextants. All teeth that present in the sextant were examined, if there was no index tooth found in that sextant and highest score represented the score of sextant. The index teeth were (17/16, 11, 26/27, 36/37, 31, 46/47).

Oral lesions examination was including inspection of intra-oral soft tissues of gingiva, oral mucosa, floor of mouth, tongue, and palate using a dental mirror. Any ulceration, erosion, bleeding, ecchymosis, petechiae, fungal infection, change of color and areas of tissue necrosis were noticed and recorded in the case sheet of each subject.

The analysis of data was performed using (SPSS version -22, Chicago, Illinois, USA). Frequency, mean, standard deviation, minimum, maximum, percentage, Chi square, Fisher exact, and two independent sample T tests were used. The significance level was when p value less than 0.05.

Results

The mean of age in the CML group was (46.700±3.544) and in the control group was (46.867±3.213). There was no significant

difference regarding age between the groups, as shown in (Table 1). For gender distribution, there was no significant difference regarding gender between the two groups as shown in (Table 1).

The mean of plaque index in the CML group was (1.605 ±0.671), which was higher than that of the control group (1.216 ±0.585), and the difference was statistically significant between the two groups (p<0.05). The mean of calculus index in CML group was (0.683±0.419), which was higher in comparison to healthy controls (0.502±0.383); the difference didn't reach statistically significant difference (p>0.05). The mean of gingival index in CML group was (1.162±0.593) which was higher than of control group (0.747±0.263) and the difference was statistically highly significant between two groups (p≤ 0.01). Clinical attachment loss and probing pocket depth were higher in CML group in comparison to healthy controls with statistically highly significant difference between two groups (p≤0.01). These results were obtained by using two independent sample T tests (Table 2).

Oral lesions was higher in CML group, 20% of CML group had an oral petechiae (no other oral lesions were observed), fisher exact test had been showed that there was statistically significant difference between CML group and healthy controls (p<0.05) (Table 3).

Table 1: Statistical test of demographic data between (CML) group and healthy controls

Age	Mean	±SD	P value
Study	46.700	3.544	0.849 NS
Control	46.867	3.213	
Gender	N	%	
CML group (Males)	16	53.33	0.301 NS
CML group (Females)	14	46.67	
Healthy controls (Males)	12	40.00	
Healthy controls (Females)	18	60.00	

Table 2: Comparison of oral health status parameters between (CML) group and healthy controls

Variables	CML group (Mean ±SD)	Healthy controls (Mean ±SD)	P value
PLI	1.605 ±0.671	1.216 ±0.585	0.020
CAII	0.683±0.419	0.502±0.383	0.085
GI	1.162±0.593	0.747±0.263	0.001
PPD	1.366 ±0.847	0.777 ±0.432	0.001
CAL	1.230 ±0.861	0.629 ±0.341	0.001

Table 3: Distribution of oral lesions between (CML) group and healthy controls

	Groups				Fisher exact	Total	
	Control group		CML group			Count	%
	Count	%	Count	%			
Not	30	100.00	24	80.00	0.024 sig	54	90.00
Petechiae	0	.00	6	20.00		6	10.00

Discussion

Chronic myeloid leukemia is hallmarked by abnormal growth of hematopoietic progenitor cells that become unable to

transfer to normal cells, leading to competition between abnormal leukemic cells and normal hematopoietic cells. Furthermore, abnormal production of the leukemic cells is linked with abnormal inflammatory signalling and immune function. This uncontrolled expansion of cells can also lead to severe symptoms such as anemia and thrombocytopenia (Baldrige, King and Goodell, 2011).

In the current study, there was no significant difference regarding age between two groups, because the selected sample ranged between 40-50 years old. This type of leukemia occurs most commonly in the middle-aged and elderly. For gender distribution, there was no significant difference regarding gender between two groups, because of the randomization in gender selection. Chronic myeloid leukemia affects both males and females with slightly male preference. These results were in consistent with previous studies (AL-Khateeb et al., 2022; Mjali et al., 2019).

In the current study, plaque index was higher in CML group than control group with statistically significant difference between the two groups, gingival index, loss of attachment and probing pocket depth were higher in CML group with a statistically highly significant difference in comparison with healthy individuals, these results were in consistent with many earlier studies (Angst et al., 2020; Ptasiwicz, Pawłowicz and Tymczyzna-Borowicz, 2020; Hussein and Hussein; Ptasiwicz et al., 2022). The reasons could be associated with diminished salivary flow rate and neglected oral hygiene as chronic myeloid leukemia cause a burning mucositis leading to pain and discomfort

during teeth brushing as well as the type of food of those patients as they had a tendency toward the soft food, so that there was more plaque on tooth surface, the extra plaque might cause swelling, bleeding and redness of gingiva leading to distortion of gingival tissues followed by destruction in periodontal attachment apparatus (AL-Ubaidi and Mahmoud, 2011; 19. Abd Ali and Abbas, 2014). The majority of CML patients received chemotherapy, the adverse effects of chemotherapy frequently occur in oral cavity, such as destroying mucosa, immune function has been inhibited, changing eating habits and oral hygiene as well as xerostomia. Dental calculus was higher in the CML group but the difference didn't reach statistically significant difference in comparison with healthy controls, this result might be explained by the presence of other factors, not only the amount of dental plaque, since the salivary flow rate and salivary composition might affect dental calculus as in previous study (Alnsudar et al., 1998). All these results were in disagreement with previous study (Radhi and Al-Waheb, 2013), this might be due to difference in sample size.

Oral lesions (petechiae) were higher in the CML group in comparison with healthy controls, with statistically significant difference. This result was matched with previous studies, (Ptasiwicz, Pawłowicz and Tymczyzna-Borowicz, 2020; Hindy, Alyassiri and Lilo, 2021; Telagi and Ahmed, 2021) which may be explained by normal hematopoietic cells suppression, leading to problems as anemia and thrombocytopenia (low platelet count) and thus leading to petechiae and gingival bleeding. This result

was in disagreement with previous study, (Angst et al., 2011) this might be due to the difference in age range of the sample.

Conclusions

Patients with chronic myeloid leukemia exhibited worse oral health conditions and more oral lesions compared to healthy individuals.

Supplementary Material

None.

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Data Availability Statement

Data are available from the authors upon reasonable request.

Conflict of interest

The authors reported that they have no conflicts of interest.

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References

1. Abd Ali, E.H. and Abbas, M.J. (2014) 'Relationship between gingival inflammation, neutrophils count in both saliva and blood in different stages of pregnant Iraqi women', *Mustansiria Dental Journal*, 11(1), pp. 142–153. Available at: <https://doi.org/10.32828/mdj.v11i1.176>.
2. Al-Khateeb, S.M., Tahir, N.T. and Al-bayati, A.A. (2022) 'Immune and inflammatory cytokines profile in Iraqi patients with acute and chronic myeloid leukemia', *Biomedicine*, 42(2), pp. 262–267. Available at: <https://doi.org/10.51248/v42i2.1321>.
3. AL-Ubaidi, R.S. and Mahmoud, M.K. (2011) 'Gingival health status among students in AL-Mustansiria University-College of Dentistry', *Mustansiria Dental Journal*, 8(2), pp. 158–163. Available at: <https://doi.org/10.32828/mdj.v8i2.320>.
4. Alnsudar, J., Kingman, A. and Brown, L. (1998) 'Gingival inflammation and subgingival calculus as determinants of disease progression in early-onset periodontitis', *Journal of Clinical Periodontology*, 25(3), pp. 231–237. Available at: <https://doi.org/10.1111/j.1600-051X.1998.tb02433.x>.
5. Angst, P.D., Dutra, D.A., Moreira, C.H. and Kantorski, K.Z. (2011) 'Gingival inflammation and platelet count in patients with leukemia: preliminary results', *Brazilian Oral Research*, 25(6), pp. 544–549. Available at: <https://doi.org/10.1590/S1806-83242011000600012>.
6. Angst, P.D., Maier, J., dos Santos Nogueira, R., Manso, I.S. and Tedesco, T.K. (2020) 'Oral health status of patients with leukemia: a systematic review with meta-analysis', *Archives of Oral Biology*, 120, p. 104948. Available at: <https://doi.org/10.1016/j.archoralbio.2020.104948>.
7. Baldrige, M.T., King, K.Y. and Goodell, M.A. (2011) 'Inflammatory signals regulate hematopoietic stem cells', *Trends in Immunology*, 32(2), pp. 57–65. Available at: <https://doi.org/10.1016/j.it.2010.12.003>.
8. Bukhari, M., Yasmin, S., Sammad, S., El-Latif, A. and Ahmed, A. (2022) 'A deep learning framework for leukemia cancer detection in microscopic blood samples using squeeze and excitation learning', *Mathematical Problems in Engineering*, 2022, p. 2801227. Available at: <https://doi.org/10.1155/2022/2801227>.
9. Francisconi, C.F., Caldas, R.J., Oliveira Martins, L.J., Fischer Rubira, C.M. and da

- Silva Santos, P.S. (2016) 'Leukemic oral manifestations and their management', *Asian Pacific Journal of Cancer Prevention*, 17(3), pp. 911–915. Available at: <https://doi.org/10.7314/APJCP.2016.17.3.911>.
10. Hindy, S.A., Alyassiri, A.M. and Lilo, A.Q. (2021) 'Chronic myeloid leukemia and associated oral manifestations', *Indian Journal of Forensic Medicine & Toxicology*, 15(1), pp. 2007–2012.
 11. Hussein, V.M. and Hussein, S.R. (year) 'Oral hygiene and pocket depth among acute myeloid leukemic adult patients in Erbil city'. [Journal details incomplete in original list].
 12. Mjali, A., Al-Shammari, H.H.J., Abbas, N.T., Azeez, Z.D. and Abbas, S.K. (2019) 'Leukemia epidemiology in Karbala province of Iraq', *Asian Pacific Journal of Cancer Care*, 4(4), pp. 135–139. Available at: <https://doi.org/10.31557/apjcc.2019.4.4.135-139>.
 13. Ptasiewicz, M., Maksymiuk, P. and Chałas, R. (2022) 'Oral hygiene considerations in adult patients with leukemia during a cycle of chemotherapy', *International Journal of Environmental Research and Public Health*, 19(1), p. 479. Available at: <https://doi.org/10.3390/ijerph19010479>.
 14. Ptasiewicz, M., Pawłowicz, A.K. and Tymczyna-Borowicz, B. (2020) 'Chemotherapy and oral health in leukemic patients', *Polish Journal of Environmental Studies*, 29(5), pp. 3931–3937. Available at: <https://doi.org/10.15244/pjoes/114234>.
 15. Quispe, R.A., Aguiar, E.M., Oliveira, C.T., Neves, A.C. and Santos, P.S. (2022) 'Oral manifestations of leukemia as part of early diagnosis', *Hematology, Transfusion and Cell Therapy*, 44(3), pp. 392–401. Available at: <https://doi.org/10.1016/j.htct.2021.08.006>.
 16. Radhi, N.H. and Al-Waheb, A.M. (2013) 'Estimation of some salivary variables and oral health status of patients with chronic myeloid leukemia aged 45-55 years', *Journal of Baghdad College of Dentistry*, 25(Special Issue), pp. 140–145. Available at: <https://doi.org/10.12816/0015129>.
 17. Ramfjord, S.P. (1959) 'Indices for prevalence and incidence of periodontal disease', *Journal of Periodontology*, 30(1), pp. 51–59. Available at: <https://doi.org/10.1902/jop.1959.30.1.51>.
 18. Ratley, A., Minj, J. and Patre, P. (2020) 'Leukemia disease detection and classification using machine learning approaches: a review', in *2020 First International Conference on Power, Control and Computing Technologies (ICPC2T)*, pp. 161–165. Available at: <https://doi.org/10.1109/ICPC2T48082.2020.9071471>.
 19. Rinaldi, I. and Winston, K. (2023) 'Chronic myeloid leukemia, from pathophysiology to treatment-free remission: a narrative literature review', *Journal of Blood Medicine*, 14, pp. 261–277. Available at: <https://doi.org/10.2147/JBM.S382090>.
 20. Silness, J. and Løe, H. (1964) 'Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition', *Acta Odontologica Scandinavica*, 22(1), pp. 121–135. Available at: <https://doi.org/10.3109/00016356408993968>.
 21. Suttorp, M., Millot, F., Sembill, S., Deutsch, H. and Metzler, M. (2021) 'Definition, epidemiology, pathophysiology, and essential criteria for diagnosis of pediatric chronic myeloid leukemia', *Cancers*, 13(4), p. 798. Available at: <https://doi.org/10.3390/cancers13040798>.
 22. Telagi, N. and Ahmed, B.M. (2021) 'A case of chronic myeloid leukemia presenting as oral ulcers', *Journal of Oral and Maxillofacial Pathology*, 25(2), p. 372. Available at: <https://doi.org/10.4103/0973-029X.325260>.
 23. World Health Organization (1997) *Oral health surveys: basic methods*. 4th edn. Geneva: World Health Organization.
 24. World Health Organization (2013) *Oral health surveys: basic methods*. 5th edn. Geneva: World Health Organization.