EFFICACY OF C-REACTIVE PROTEIN AND WBC COUNT IN FASCIAL SPACE INFECTIONS OF ODONTOGENIC ORIGIN

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ABSTRACT

INTRODUCTION

Maxillofacial infection is one of the life-threatening conditions. The signs and symptoms alone, may not always be sufficient to judge the severity of infectious process. white blood cells (WBC) counts and C-reactive protein (CRP) levels help to monitor infections in terms of severity, clinical features and duration of hospital stay. So, the present study was aimed to compare the efficacy of CRP level and WBC count in fascial space infections of odontogenic origin.

MATERIAL AND METHODS

A total of 31 patients of fascial space infection of odontogenic origin aged 11 to 64 years were included in the study. Clinical details were recorded after thorough clinical examination. Venous blood samples from patients were collected on pre-operative day (Day 0), 2nd post-operative day (Day 2) and 5th post-operative day (Day 5) to measure CRP level and WBC counts.

RESULTS

Out of 31 patients, 20 (64. 51%) patients had high WBC counts whereas all patients had high CRP levels on Day 0. On day 2 and day 5 when compared to day 0, WBC and CRP level decreased significantly. On Day 5 alone when compared to Day 2, CRP level decreased significantly (p<0.001) and had positive correlation with duration of hospital stay (r = 0.51, p = 0.003).

CONCLUSION

CRP levels had a high sensitivity for diagnosis of odontogenic fascial space infection. It showed a more consistent correlation with the clinical features and significant positive correlation with duration of hospital stay. Thus, CRP should be assessed to monitor fascial space infections as routine practice.

KEYWORDS

Infection, Odontogenic infection, Space infection, WBCs, CRP

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https://doi.org/10.3126/jucms.v12i02.69488

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INTRODUCTION

The human oral cavity is considered to be sterile at the time of birth.[1,2] However, it gets harbored with a diverse, indigenous flora which includes bacteria, viruses, fungi and, protozoa during growing age. The path of a spread of odontogenic infection in fascial space is well documented. The spread of infection from maxillary teeth commonly involves the buccal space, canine spaces, and rarely the infratemporal space which may later spread to the temporal, parotid, lateral, and retropharyngeal spaces as secondary spaces.[3,4] Rarely, they may lead to an orbital abscess, cavernous sinus thrombosis and cerebral abscess.[5,6] Spread of infection from mandibular teeth commonly involves submandibular, sublingual, buccal, pterygomandibular, or sub-masseteric spaces which later on may spread to secondary spaces like the lateral pharyngeal or retropharyngeal spaces, leading to acute upper airway obstruction due to the mass effect.[4] It can also spread vertically in temporal and infratemporal spaces.[7] While the further spread of the infection via fascial planes can lead to necrotizing fasciitis, thrombosis of the jugular vein, erosion of the internal carotid artery, mediastinitis, septicemia and multiorgan failure.[8,9] Early recognition and treatment of odontogenic infections is required and delayed or less aggressive treatment increases morbidity and mortality.[10]

Clinical signs may sometimes appear late or may be insufficient to give a precise assessment of an infectious process. Many laboratory markers, radiographs, and culture and sensitivities have been used to predict the severity and course of infections, thereby avoiding the potential risk for further complications. These laboratory markers include white blood cells (WBC) counts, erythrocyte sedimentation rate (ESR), pre-albumin, procalcitonin and C-reactive protein (CRP).[11]

CRP is one of the most dynamic acute phase proteins in the pentraxin protein family which is present in small amounts (<6 mg/L) in a normal healthy people.[12,13] Its serum concentration can increase up to 1000-fold or more in response to various acute stimuli associated with infections and other types of tissue injuries.[12,14] CRP has a very short half-life of 5–7 hours as compared to a life span of 5–6 days for leucocytes.[14,15]

Due to scarce of literatures, the role of WBC and CRP in predicting clinical features, treatment outcomes and duration of hospital stay were less available.[16,17] Thus, the present study aimed to analyze the efficacy of CRP levels and WBC counts in fascial space infections of odontogenic origin.

MATERIAL AND METHODS

An observational analytical prospective study was conducted in 31 patients who visited the Department Oral and Maxillofacial Surgery or Department of Emergency of Universal College of Medical Sciences, Bhairahawa, Nepal from January 2021 to June 2023 for the treatment of acute odontogenic infections of the head and neck. Ethical approval was obtained from the Institutional Review Committee of Universal College of Medical Sciences. Informed written consent was taken from all the patients and confidentiality was maintained regarding patients' information.

A detailed history was taken and a thorough clinical examination of patients was done with standard protocol by an Oral and Maxillofacial surgeon.

During examination, these following clinical parameters were recorded; demographic data of patients, swelling, active pus discharge, pain (using Numerical Rating Scale scoring from 1 to 10), body temperature in fahrenheit by a mercury thermometer, dental etiology/teeth involved and fascial space/spaces involved.

For swelling and active pus discharge; three different oral and maxillofacial surgeons independently assessed and gave a score 0 if absent or 1 if present. Then mode of the score was recorded.[10,18] Numeric rating scale (NRS) was used for assessment of pain. Reference values were given to the patient and asked to say the number that fits well to their intensity of pain. It has a numeric value between 0 and 10 where 0 represents 'no pain at all' and the upper limit represents 'the worst pain ever possible'.[19,20]

Clinical parameters were recorded in 3 scheduled times as shown below:
Day 0 - Pre-operatively before starting any treatment
Day 2 - Second post-operative day after surgical treatment
Day 5 - Fifth post-operative after surgical treatment
After history taking and clinical examination, the patients' venous blood samples were collected at the aforementioned scheduled time from anti-cubital vein. During specified time interval approximately 4 ml of blood was withdrawn; out of which 2 ml each was used to measure CRP level and 2 ml was used to determine WBC counts. CRP level was evaluated by quantitative immunoturbidimetry and rate nephelometry method (mispa-i3/AGAPPE®), WBC count were evaluated by the automated hematology cell counter (DxH500, Beckman Coulter®).

Statistical analysis was performed using SPSS 20. Kolmogorov-Smirnov test was done to determine the normality of the data and the result shows most of these data were non- parametric. So, non-parametric tests including the Wilcoxon test, Mann-Whitney U test and Spearman correlation analysis used to analyze the data.

RESULTS

This study consisted of 11 male and 20 female patients, between 11 years to 64 years in age with the mean age of 37.06 ±14.78 years. Fascial space infections of odontogenic origin were most common in 3rd decade. The most common etiology was dental caries (80.6%) followed by pericoronitis around impacted teeth. Other etiologies include dental trauma and periodontitis. Mandibular teeth were involved in 28 cases (90.3%) and Maxillary teeth were involved in 3 cases (9.7%). Submandibular space was most commonly involved and found to be in 18 patients (58.06%). Buccal space infection was the second most common and seen in 17 patients (54.83%). In one patient (3.23%), infection had spread to the mediastinum.

On the day of diagnosis, out of 31 patients, all the patients had high CRP level but only 20 patients had high WBC count. In the second postoperative day, high WBC counts found in 10 patients while a high CRP level found in 25

patients. In the 5th postoperative day, a high WBC count found in 5 patients and a high CRP level seen in 9 patients as shown in figure 1.

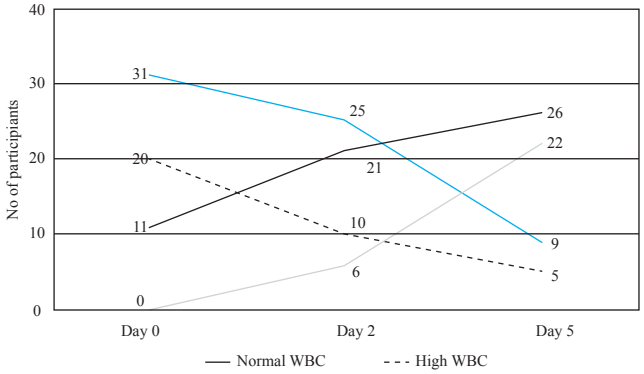

Figure 1. Number of participants with normal or high WBC and CRP level in Day 0, Day 2 and Day 5.

Median WBC counts (25th –75th percentile) of those day was 11700 cells/µL (9000 –16400 cells/µL), 9800 cells/µL (9000 –12300 cells/µL) and 9600 cells/µL (8700 –10900 cells/µL) respectively. Wilcoxon signed-rank test (WSRT) had indicated that the WBC count rank of Day 2 was statistically significantly lower than the Day 0 rank (Z= -3.32, *p*= 0.001), WBC counts of Day 5 rank lower than the Day 2, but it was not statistically significant (Z= -1.9, *p*= 0.054) as shown in figure 2.

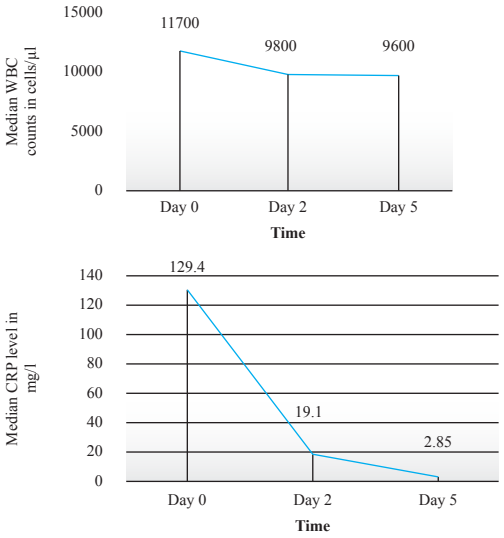

Figure 2. Comparisons of median WBC counts and CRP level in Day 0, Day 2 and Day 5

Similarly, median CRP level with (25th –75th percentile) on those day was 129.400 mg/L (69.30 mg/L – 163.00 mg/L), 19.10 mg/L (8.10 mg/L –34.00 mg/L), 2.85 mg/L (1.00 mg/L – 7.00 mg/L) respectively. WSRT had indicated that CRP level Day 2 rank was statistically significantly lower than the Day 0 rank (Z= -4.74, *p*<0.001) as well as CRP level Day 5 rank was statistically significantly lower than the Day 2 rank (Z= -4.68, *p*<0.001) as shown in figure 2.

The mean temperature of the participants on Day 0, Day 2 and Day 5 was 99.27 ±1.36°F, 97.92 ±0.52 °F and 97.63 ±0.47°F respectively. On Day 0, WBC counts had a negligible positive correlation with temperature, which was not statistically significant (r=0.27, *p*=0.134), while CRP had a significant weak positive correlation with temperature on the same day (r =0.36, *p*=0.045). Mean pain score on Day 0, Day 2 and Day 5 was 9.65 ± 0.66, 2.32 ± 1.37 and 0.26 ± 0.57 respectively. On Day 0, WBC counts and CRP levels had a statistically insignificant correlation with pain score.

The swelling was present in all patients on Day 0. On Day 2, 11 patients had swelling in decreasing order. Mean WBC counts of patients with and without swelling were 11618.18 cells/µL and 10775.00 cells/µL respectively. The mean rank of WBC with swelling and without swelling was 16.36 and 15.8 respectively and the difference was not significant statistically (Mann Whitney U value=106, *p*= 0.86). On same day the mean CRP of patients with and without swelling was and 42.72 mg/L and 16.85 mg/L respectively. The mean rank of CRP with swelling and without swelling was 23.45 and 11.9 respectively and the difference was statistically significant (Mann Whitney U value=28, *p*= 0.0001).

The patients were admitted to the hospital minimum for 1 day and maximum for 19 days with the average stay of 6.1± 4.06 days. Spearman correlation analysis showed there was a negligible positive correlation between WBC count in the day of diagnosis and day of hospital stay which was not significant statistically (r =0.22, *p*= 0.226), whereas CRP levels on the day of diagnosis had a significant moderate positive correlation with hospital stay (r = 0.51, *p*= 0.003).

DISCUSSION

The fascial spaces of head and neck region are the potential spaces between the various layers of fascia normally filled with loose connective tissue and bounded by anatomical barriers, usually of bone, muscle or fascial layers.[21] Spread of infection to these spaces lead to significant morbidity and mortality when not properly managed. Maxillofacial space infections have several etiologies such as odontogenic cause, upper respiratory tract infection, penetrating trauma, and malignancies. The most common etiology of fascial space infection in adult is odontogenic infection whereas in children is upper respiratory tract infection.[22]

In past, the complete blood count (CBC) was chief indicator for diagnosis of infection.[23] Total and the differential leucocyte counts have been used since 95 years to evaluate infectious diseases. Normal value of TLC ranges from 4000–11,000 cells/µL in a healthy adult. WBCs are produced, transported and distributed as a part of the immune response. In response to acute infection or inflammation, the number of WBC's increases.[14]

Out of 31 patients, 20 patients had high WBC counts whereas high CRP levels were observed in all the patients on Day 0 which indicate WBC counts had 64.51% and CRP levels had 100% sensitivity for diagnosis of fascial space infection of odontogenic origin. Similarly, Bali et al[14] also reported that the CRP levels were increased in all (100 %) patients as compared to TLC counts which were increased only in 64 % patients. The higher sensitivity of CRP as compared to WBC counts might be due to early rise in its level as compared to WBC counts in odontogenic infection.

The present study showed slight high WBC count (13325.81±5570.21/μL) on the day of diagnosis. These findings are in accordance with studies done by Bali et al,[14] Heim et al[16] and Bakathir et al[24] While comparing WBC count on Day 0 with 2nd post- operative day and 5th postoperative day, there was significant decrease in WBC counts ($Z= -3.32$, $p<0.001$) and ($Z= -3.66$, $p<0.001$) respectively which is similar to the study done by Bagul et al[23] but WBC counts in Day 2 and Day 5 were not different significantly. The reason might be that WBC counts decrease after resolution of infection but it could not decrease in short time period due to longer life cycle of WBC in blood.

Heim et al[16] reported that mean CRP level on the day of diagnosis were 108.78 mg/L. The mean CRP level of our study is also 113.62 ± 54.05 mg/L on the day of diagnosis. However, different levels of mean CRP levels were reported by Mirochnik et al[25] (48.8 mg/L-75mg/L) and Bakathir et al[24] (126.9 mg/L) on the day of diagnosis. These variation in CRP level may be multifactorial and depends on timing, severity and different armamentariums used. There was significant decrease in CRP level while comparing Day 0 and Day 2 ($Z= -4.74$, $p<0.001$) , Day 0 and Day 5 ($Z= -4.86$, $p<0.001$) as well as Day 2 and Day 5 ($Z= -4.68$, $p<0.001$). This finding was in accordance with Bali R et al,[14] and Bagul et al[23] Rapid fall in CRP level may be due to its short half -life of 5–7 hours.

Our study showed the mean hospital stay of 6.1±4.06 days. In contrast, the study done by Heim et al[16] and Kaur et al[10] showed that mean hospital stay was 2.7 days and 2.16 days respectively. This study showed negligible positive correlation between WBC count in day of diagnosis and hospital stay and was not statically significant ($r = 0.22$, $p = 0.226$) but Kaur et al[10] found that statistically significant relationship between them. In the present study, CRP level on day of diagnosis had significant moderate positive correlation with hospital stay ($r = 0.51$, $p = 0.003$) and was in accordance with Kaur et al[10] and Sharma et al[15] where they found that a linear relationship between CRP and hospital stay. Thus, CRP level could be a good biomarker than WBC counts for prediction of hospital stay.

CONCLUSION

As compared to WBC counts, CRP levels had high sensitivity for diagnosis of odontogenic fascial space infection. It was found to be a more consistent indicator for monitoring the patients fascial space infection. In addition, CRP had significant correlation with hospital stay. Thus, CRP should be incorporated as monitoring tool for managing patients with fascial space infections of odontogenic origin. As this study had small sample size, further studies with larger sample size is required to verify these findings.

CONFLICT OF INTEREST

None

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