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Original Article

Correlation Between the Severity of Chronic Rhinosinusitis and The Degree of Osteitis Based on Computerized Tomography Evaluation

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Abstract

Background : The incidence of chronic rhinosinusitis (CRS) is increasing every year, characterized by inflammation of the nasal and paranasal sinuses mucoperiosteum for more than 12 weeks. The inflammatory process of CRS sometimes spreads to the surrounding bone tissue resulting in osteitis. Computerized tomography scan (CT scan) can assess the degree of mucosal inflammation using the Lund-Mackay score (LMS) while the degree of bone thickening and remodelling are assessed with Global osteitis score (GOS) and Kennedy osteitis score (KOS). This study was aimed to evaluate the correlation between CRS severity assessment using LMS and osteitis severity assessment using GOS and KOS

Methods : A retrospective analysis using a cross-sectional design was conducted that included 63 CT scans of the paranasal sinus of CRS patients. The spearman rank test was used to analyze data.

Results : Assessment using LMS showed 44% patients were classified as severe, while 29% and 27% patients were classified as moderate and mild respectively. Global osteitis score showed 2% patients were categorized as severe, while 22% and 46% patients were categorized as moderate and mild respectively, and 30% patients were not significant. Based on KOS assessment, it was found that 3% patients were classified as severe, while 38% and 59% patients were classified as moderate mild respectively. There was a significant correlation between CRS severity using LMS and GOS (p 0.000) with rho= 0.951. There was a significant correlation between CRS severity using LMS and KOS (p 0.000) with rho value= 0.452.

Conclusion : This study shows a significant correlation between CRS severity assessment using LMS and bone thickening and remodelling assessment using GOS and KOS. In comparison with KOS, GOS has stronger relationship with LMS.

Keywords : chronic rhinosinusitis; Lund-Mackay CT Score; Global Osteitis Score; Kennedy Osteitis Score

INTRODUCTION

Chronic rhinosinusitis (CRS) is inflammatory of the nasal periosteum lining and paranasal sinuses that last more than 12 weeks or more than 3 recurrence episodes in the 6 months period.[1] The CRS related-paranasal sinuses mucosal changes can be driven by two etiologies; allergy and non-allergic factors. Allergic mediated-CRS is characterized by predominance of eosinophil in the nasal mucous and secretions, while non-allergic CRS is characterized by the presence of purulent secretions and predominance of neutrophil in the mucous layer. Clinical symptoms of CRS includes nasal congestion, colored nasal discharge, facial pain and smell disorder or cough.[2]

The incidence of chronic rhinosinusitis in the United States is 14.1% among adult population. Indonesian Ministry of Health in 2013 stated that rhinosinusitis was the 25th most prevalent disease accounting for 102.817 patients in the hospital. Between January and August 2016, Rhinology division of Otorhinolaryngology department of dr. Cipto Mangunkusumo General Hospital reported 435 rhinology patients in which 69% of them was diagnosed rhinosinusitis indicated for functional endoscopic sinus surgery (FESS).[3]

The inflammatory process of CRS is not limited to the mucosa, but sometimes spreads to the surrounding bone tissue and involves the sinus bone below the mucosa, resulting in osteitis.[4,5] Bone involvement in CRS are referred as osteitis/osteomyelitis/hyperostosis/bone hyperplasia and neo-osteogenesis. The term of osteitis is recommended due to the absence of marrow in the flat bones around the sinuses except in the frontal sinus.[6]

The gold standard of radiology examination for CRS diagnosis is Computerized Tomography scan (CT scan) of paranasal sinuses without contrast; using Lund Mackay Score (LMS) method for interpreting the degree of sinusitis.[7,8] The Lund Mackay scoring system has limitations due to nonlinearity and limited sensitivity for mild to moderate disease assessment.[9] Osteitis is defined as hyperostosis, bone involvement, new bone formation, neo-osteogenesis or osteoneogenesis, and chronic osteomyelitis in any sinus wall. Severity of osteitis in CRS can be assessed using Global Osteitis Score (GOS) and Kennedy Osteitis Score (KOS).[2,4]

The CRS assessment using LMS cannot determine recurrences and prognosis of CRS.[9] Many clinicians considered osteitis grading is better than LMS. To date, there is no study comparing osteitis severity score between GOS and KOS. Therefore, we want to examine the correlation between the severity of CRS using LMS method and osteitis grading using GOS and KOS.

METHODS

We conducted a retrospective study with cross-sectional design. Data were gathered from electronic medical records of patients aged 18 years or older with positive result of plain paranasal sinuses CT between June 2022 and May 2023 in Radiology Unit of Dr. Kariadi General Hospital, Semarang. Patients with sinonasal tumours, maxillofacial injury, and history of nasal or sinus surgery were excluded. This study was approved by Health research ethics committee of RSUP Dr. Kariadi Semarang.

The sinusitis severity was assessed using the Lund Mackay Score with a total score of 24. The mucosal thickening in each right and left sinus was categorized into 0 (no abnormality), 1 (partial opacity), and 2 (total opacity), while the right and left osteomeatal complex were classified into 0 (no occlusion) and 2 (closed osteomeatal complex).[7,8,10] The classification of osteitis severity was based on the Global Osteitis Score assessed in 10 sinuses (right and left side of frontal, anterior ethmoid, posterior ethmoid, maxillary, and sphenoid sinuses), and categorised as no osteitis (score <5), mild (score 5–20), moderate (score 20–35), and severe (score >35). The Kennedy Osteitis Score were classified into 0 (<3mm), 1 (3–5 mm), and 2 (> 5mm).[11,12]

The CT scan examination was conducted using a Siemens Syngovia Sensation 128 slice CT and General Electric Optima 16 slice CT. The CT without contrast of paranasal sinuses of axial and coronal planes with field of view paranasal sinuses 150–200 mm, window width 2000, window centre 200; scanner setting: kVp: 120 mAs; 200, and pitch: 1.4.

Statistical software of SPSS 20.0 was used. The Spearman rank test was used to analyse data as the quantitative variables were not normally distributed. All conclusions were based on significance level of $p<0.05$ and are confirmed by correlation coefficient.

RESULTS

Sixty-three patients who met the inclusion and exclusion criteria were assessed; consisting of 26 (41.3%) female and 37 (58.7%) male subjects. The majority of subjects were in the age group of 18–77 years with the average age was between 18–30 years followed by 18 patients (27%) aged 18-30 years, 9 patients (14%) aged 31–40 years, and 13 patients (20%) aged 41–50 years, 14 patients (21%) aged 51–60 years, and 9 patients (14%) aged older than 60 years old.

The lowest and highest value of the Lund-Mackay CT score were 1 and 24 respectively with mean score and standard deviation of 10 and 7 respectively. The lowest and highest value of the Global Osteitis Score were 1 and 38 respectively with the mean score and standard deviation of 13 and 11 respectively. The lowest and highest value of the Kennedy Osteitis Score were 0 and 8 respectively with mean score and standard deviation of 1 and 2 respectively. The most common severity in osteitis was mild either with Global Osteitis Score (46%) or

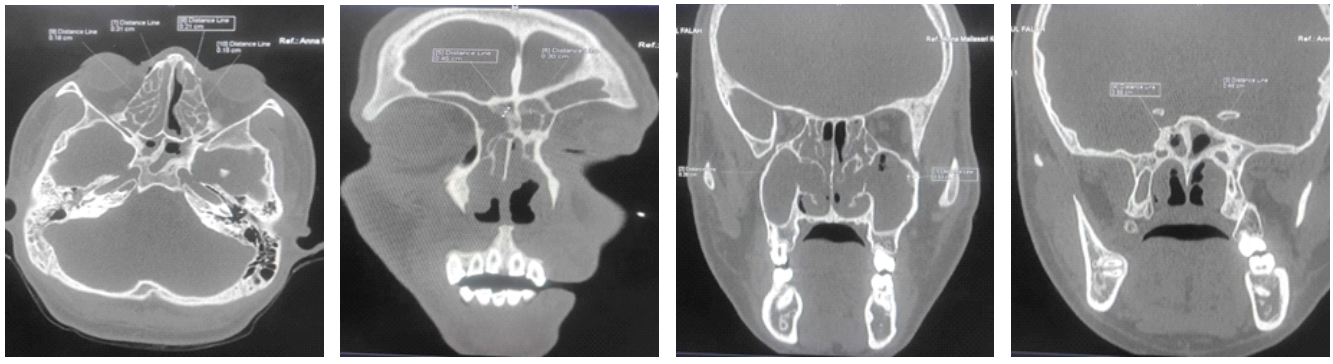

Figure 1. Measurement of the rhinosinusitis severity, Lund Mackay CT score (LMS) = 22, Global Osteitis Score (GOS) = 38 and Kennedy Osteitis score = 8

TABLE 1
Characteristic of Paranasal Sinuses Severity Score

Characteristis		Percentage
Lund-Mackay CT Score	Mild	17 (27%).
	Moderate	18 (29%)
	Severe	28 (44%)
Global Osteitis Score	Mild	29 (46%)
	Moderate	14 (22%)
	Severe	1 (2%)
Kennedy Osteitis Score	Mild	37 (59%)
	Moderate	24 (38%)
	Severe	2 (3%)

Kennedy Osteitis Score (59%).

We found a significant positive correlation between Lund-Mackay Score and Global Osteitis Score (p=0.000 and r= 0.951) with strong correlation coefficient of >0.70 (Figure 2). There was a significant positive correlation between Lund Mackay Score and Kennedy Osteitis Score (p=0.000 and r=0.452 with moderate correlation coefficient of 0.40- 0.70 (Figure 3).

DISCUSSION

The study determined CRS with and without nasal polyps shows the age-specific prevalence estimates varied between 18.8 (95% CI, 18.7–18.9) and 23.3 (95% CI, 23.1–23.5) per 1000 CI, 23.1–23.5) per 1000 population during 2004–2005 to 2013–2014, and no clear increasing trend was found. Based on age group, the prevalence of CRS with nasal polyps increases with age in adults (≥18 years) and is particularly pronounced after the age of 40 years, whereas CRS without nasal polyps is more prevalent at the age less than 40 years.[1] This is in accordance with the results obtained in this study with most rhinosinusitis patients in young adult and incidence rate decreased among patients older than 60 years.

Osteitis is a process of simultaneous increased activity of osteoblasts and osteoclasts in varying proportions resulting in disruption of flat bone formation and immature woven bone formation.[6] Osteitis is also defined as a process of new bone formation and bone remodelling within the paranasal sinuses, and is characterized by thickening of the periosteum, new woven bone formation, bone resorption, and fibrosis.[13] The presence of chronic inflammation in RSK that is not limited to the mucosa can cause inflammation to the surrounding bone tissue and especially involve the sinus bone under the mucosa resulting in osteitis.[4,5] The severity of bone thickening of the paranasal sinuses assessed by the GOS score is known to correlate with sinus mucosal inflammation. Therefore, in cases of eCRS recurrence, osteitis of the paranasal sinuses is suspected to be involved.[5] Osteitic changes are often found even in non-operated patients.[14]

In CRS, there is a scoring system for osteitis called Global osteitis scoring (GOS), which has been

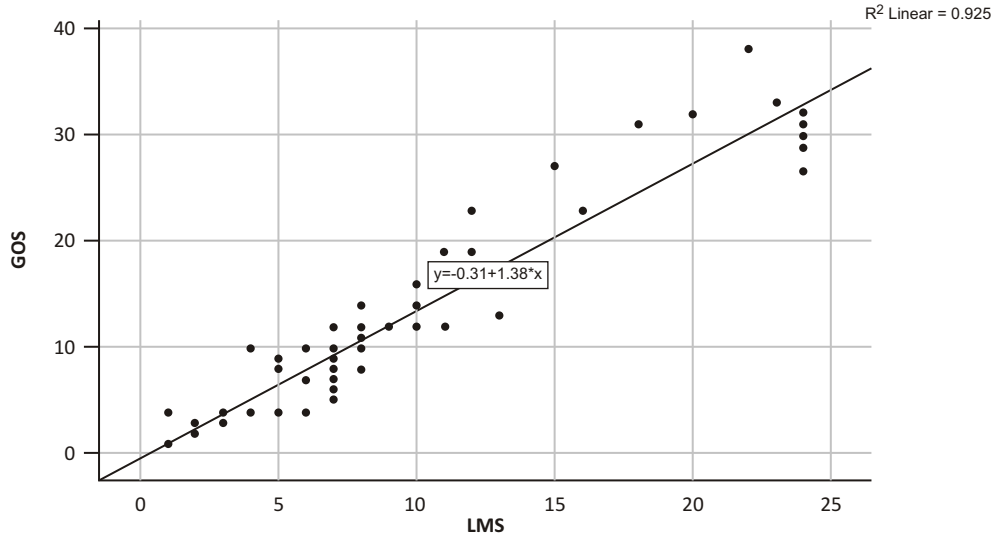

Figure 2. Correlation between Lund Mackay CT score (LMS) and Global Osteitis Score (GOS), Spearman test results with a *p value:* 0.05 and rho: 0.951

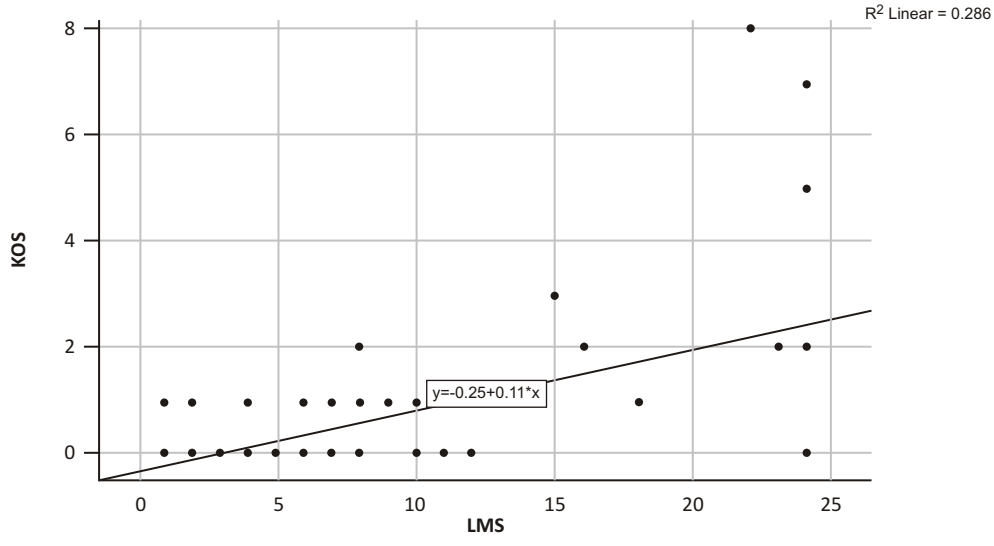

Figure 3. Correlation between Lund Mackay CT score (LMS) and Kennedy Osteitis Score (KOS), spearman test results with a *p value:* < 0.05 and rho: 0.450

investigated with cross-sectional RSK studies. The maximum score for sinus in GOS is achieved when the wall thickness is 5 mm or more.[15] Snivdong study showed the correlation between LMS and GOS of score 0 (p<0.001) and the correlation between LMS and KOS of score 0 (p<0.001). Kennedy Osteitis Score is positively correlated with CT score (p= 0.001). Our findings showed that LMS is significantly positively correlated with GOS and KOS (p *value* <0.05). Bone thickness assessment and osteitis grading in all 10 (right and left side of frontal, anterior ethmoid, posterior ethmoid, maxilla, and sphenoid) sinuses were conducted to improve assessment method. Kennedy Osteitis Score is not only a useful and easier tool but also highly reproducible by measuring the maximum thickness of sinus wall. Global Osteitis Score may be more complex for assessing severity (bone thickness) and extent of change but it may be potentially better for describing area involvement. A significant correlation was demonstrated between the two grading systems in this study. Chronic rhinosinusitis patients with osteitis reported more severe disease and less functional improvement.[16]

Osteitis severity in CRS can be determined using several methods. The most frequently used osteitis index is GOS and KOS index. We used LMS with GOS and LMS with KOS to assess osteitis severity. In comparison with

plain radiographs, CT scans can provide more detailed information regarding erosion and abnormalities of the bone structure of the paranasal sinuses; including bone thickness, sinus involvement, and the number of sinuses involved which is used for assessing osteitis severity using GOS and KOS.[17]

In this study we only analysed the severity of CRS using tomography computer with only single expertise, we did not analyse the disease severity with clinical features, endoscopy, and histopathological findings in our subjects. Further researches are needed to identify the correlation between osteitis grading and clinical features, endoscopy, and histopathological findings in chronic rhinosinusitis patients. It is imperative to conduct a systematic review and or meta-analysis to assess the correlation between Global Osteitis Score and Kennedy Osteitis Score; and chronic rhinosinusitis severity.

CONCLUSION

This study shows significant correlation between CRS severity assessment using LMS and bone thickening and remodelling assessment using GOS and KOS. LMS has a stronger positive correlation with GOS in comparison with KOS.

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