The Value of CT Severity Score versus Symptoms Severity Score in Adult Patients with Chronic Rhino-Sinusitis

Mohammed Abd Kadhim*, Rasha Majid Ahmed**

ABSTRACT:

BACKGROUND:
Chronic rhinosinusitis (CRS) is an inflammatory disorder of paranasal sinuses. The computerized tomography (CT) scan remains the common diagnostic modality for diagnosis of paranasal diseases.

AIM OF STUDY:
To evaluate the value of CT scan in the management of chronic rhinosinusitis by correlating preoperative symptoms severity score as well as overall disease severity score of CRS depending on radiological findings on CT scan.

PATIENTS AND METHODS:
A cross-sectional analytic study conducted in Computerized Tomography (CT) unit of Al-Emamain Al Kadhimain Medical City in Baghdad/Iraq during the period from 1st of July to 31th of December, 2019 on sample of 100 CRS patients (58 male - 42 female). The diagnosis of CRS disease was done by Otolaryngology Specialist depending on history and clinical examination the data were collected from the patients directly and filled in a prepared questionnaire.

RESULTS:
There was a strong positive significant correlation between CT scan Lund Mackay (L-M) score of CRS patients and CS score (r=0.89, p<0.001). Mean L-M score was significantly higher among CRS patients with high risk of CS score (>40) (p<0.001). L-M CT score was higher in males (1.3:1) and in extremes of age .The acceptable cut off points and the corresponding validity values for L-M score level in prediction of high risk was 11.5 with acceptable validity results (90% sensitivity, 80% specificity and 86% accuracy).

CONCLUSION:
The computerized tomography scans Lund Mackay score had good correlation with clinical symptoms of chronic rhinosinusitis.

KEYWORDS: Chronic Rhinosinusitis, CT severity score, Symptom severity score.

INTRODUCTION:

Chronic rhinosinusitis is an inflammatory condition of the paranasal sinuses that most often causes chronic sinonasal symptoms [1, 2]. Because the pathophysiology of chronic rhinosinusitis in children is distinct from that in adults, the medical and surgical approach differs significantly between children and adults [3]. For many years, chronic rhinosinusitis (CRS) was commonly identified solely on the basis of the patient's subjective symptoms [4].

In order to confirm a diagnosis, the symptom-based definition was reevaluated by the use of either radiological imaging or nasal endoscopy [5], and due to the relatively unsatisfactory specificity and positive predictive value of symptom-based diagnostic criteria, many physicians rely extensively on CT findings [6].

Computed tomography (CT) imaging remains the modality of choice for the diagnosis and evaluation of inflammatory diseases of the sinonasal cavities [7]. Multidetector CT (MDCT) allows assessment of the patency of sinonasal passages and shows the effect of anatomic variants, inflammatory disease or both on patency. MDCT can show anatomic structures that are not visualized by physical examination or diagnostic nasal endoscopy and is, hence, the study of choice for the surgeon who is considering functional endoscopic sinus surgery [8]. CT aids in the diagnosis and management of recurrent and chronic sinonasal disease by determining the distribution and extent of disease [9]. CT is the investigation of choice for pre-operative evaluation of the nasal cavity and paranasal sinuses and is the gold standard for description of inflammatory sinus disease resulting from obstruction [10]. CT is the preferred study for Functional Endoscopic Sinus Surgery (FESS) because coronal images mimic

*Professor in Medical Collage/ Al-Nahrain University/ Baghdad Iraq.
**Radiologist in Al-Imamian Al-Kadhimyian Medical City/ Baghdad Iraq.

the appearance of the sinonasal cavity from the perspective of the endoscope [11]. CT helps in the diagnosis of the anatomic variations that may lead to intra-operative and post-operative FESS complications and reduces the mortality and morbidity of patients, so a combination of CT and diagnostic endoscopy has become the mainstay in evaluation of the sinonasal diseases [12]. Distinguishing patients for whom ESS will likely be effective and result in enduring abatement of interminable CRS remains problematic, and numerous specialists have switched to radiographic staging to identify prognostic components that may influence post-ESS results [13]. Some data suggest that the preoperative CT scan stage may predict the degree of symptom improvement after ESS [14].

The L-M staging system is a measure of the degree of opacification in the paranasal sinuses. When inflammation occupied 0% of the CT image, a score of 0 was assigned; a score of 2 was assigned when the changes occupied 100% of the sinus. All other degrees of inflammation was scored as 1. For the ostiomeatal complex (OMC): 0 = not occluded; 2 = occluded. The total score might range from 0 to 24 [4, 15].

AIM OF STUDY:
To evaluate the value of CT scan in the management of chronic rhino-sinusitis (CRS) by correlating preoperative symptoms severity score as well as overall disease severity score of CRS with radiological findings on CT scan.

PATIENTS & METHODS:
Study design and settings: This study is a cross sectional analytic study conducted in Computerized Tomography (CT) unit of Al-Emamain Al Kadhimain Medical City in Baghdad/Iraq during the period from July to of December, 2019.

Ethical considerations: The approval was taken from Scientific committee of diagnostic radiology in the Iraqi board of medical specialization, an oral informed consent was taken from all the patients included in the study.

Inclusion criteria: adult patients with history of CRS refractory to medical treatment for 12 weeks.

Exclusion criteria: patients younger than 18 years, acute rhinosinusitis (less than 4 weeks), history of sinonasal trauma, tumor in the PNS,

previous surgery in the PNS and inverted papilloma.

Sampling: A convenient sample of 100 CRS patients referred to CT unit of Al-Emamain Al Kadhimain Medical City was selected after eligibility to inclusion and exclusion criteria.

Data Collection:
The data was collected from the patients directly and filled in a prepared questionnaire. The questionnaire was designed as a visual analogue symptoms score. The questionnaire was designed by the researcher and supervisor. The questionnaire included the following: demographic characteristics of CRS patients (age and gender), clinical severity score which was calculated according to symptoms and score (figure 1) and CT scan findings of CRS patients: (frontal sinus, maxillary sinus, anterior ethmoid sinus, posterior ethmoid sinus, sphenoid sinus and osteomeatal complex) on both sides, septal deviation of CRS patients, clinical symptoms (CS) scores of CRS patients, and Land-Mackay (L-M) score of CRS patients (the reader assigns each sinus a score of: 0 (no abnormality), 1 (partial opacification) or 2 (complete opacification), the ostiomeatal complex is assigned a score of either 0 (not obstructed) or 2 (obstructed)).

Patients' assessment:
The diagnosis of CRS disease was done by Otolaryngology Specialist depending on history and clinical examination. The researcher collected the cases of CRS referred to CT unit from Otolaryngology unit for imaging. The CT scan was interpreted by researcher and Senior radiologists in CT unit. The CT scanner was Definition Edge 64 slice (Siemens medical system, Germany). Slice thickness 0.6mm, mAs 35- 48 with Kv 100- 120. The CT scan examination was done carried out in axial plan with the patient lying supine, no special preparation is needed. Coronal and sagittal images of paranasal sinuses were obtained by reconstruction algorithm into 0.6mm. The data were transferred into computer workstation with DICOM viewer and interpreted by the supervisor. The clinical finding of CT scan for paranasal sinus was scored by the supervisor and researcher by assigning score for each sinus and the osteomestal complex on both sides and the sum of these scores leads to calculation of CT scan Lund Mackay score.
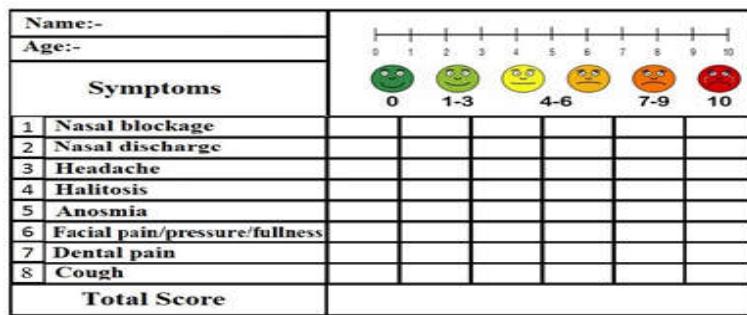
Figure 1: calculation of the clinical severity score of patients with CRS

Statistical analysis:

All patients' data were entered using computerized statistical software; Statistical Package for Social Sciences (SPSS) version 20 was used. Descriptive statistics were presented as (mean ± standard deviation) and frequencies as percentages. Multiple contingency tables were conducted and appropriate statistical tests performed, Chi-square test was used to compare between categorical variables (Fishers exact test was used when expected variable was less than 20% of total). In all statistical analysis, level of significance (p value) set at ≤ 0.05 and the result presented as tables and/or graphs.

RESULTS:

This study included 100 Chronic Rhinosinusitis (CRS) patients with mean age of 39.1±14.7 years; Male were more than female with male to female ratio as 1.3:1.

The Land-Mackay score of CRS patients was 10.1±6.3 and clinical symptoms score was 30.4±20.3; 70% of CRS patients were at low risk (CS score≤40) and 30% of CRS patients were at high risk (CS score>40).

Mean of clinical symptoms score was significantly increased with complete opacification detected by CT scan of all the para-nasal sinuses on both sides. All these findings were shown in table 1. Similarly mean CS score was significantly increased among CRS patients with obstructed OMC (p<0.001).

Table 1: Distribution of clinical symptoms (CS) scores (mean±SD) according to CT of paranasal sinuses.

CS scores Mean±SD	No abnormality		Partial opacification		Complete opacification		P value
	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	
Frontal	20.7±12.2	19.8±12	33.1±22.2	37.4±20.2	57.1±12	58.1±11.9	**<0.001***
Maxillary	17.7±10.9	17.3±8.6	26.1±22.2	27.4±18.6	39.6±18.1	43.3±21.1	**<0.001***
Ant. ethmoid	14.3±8.3	16.7±11.4	25.9±17.8	30.2±19.9	45.4±17.2	43.7±18.7	**<0.001***
Post. ethmoid	15.5±8.8	21.2±13.3	30.7±19.8	26.4±17.9	45.4±18.1	44.4±21.5	**<0.001***
Sphenoid	27.5±19.6	22.8±15.9	32.3±17.8	45.2±18.7	60.8±6.5	48.3±24.8	**<0.001***

*One way ANOVA analysis, S=Significant.

Both L-M and CRS scores were significantly higher among male patients (p=0.008, p<0.001, respectively). All these findings were shown in table 2.

Table 2: Distribution of L-M and CS scores according to CRS patients' gender.

Variable	Male	Female	P value
L-M score (Mean±SD)	11.5±6.5	8.1±5.3	0.008* [S]
CS score (Mean±SD)	37.3±20.3	20.8±15.9	<0.001*[S]

*Independent sample t-test, S=Significant.

There was a strong positive significant correlation between CT scan L-M score of CRS patients and CS score (r=0.89, p<0.001). Also mean L-M score was significantly higher among CRS patients with high risk of CS score (>40) (p<0.001).

The acceptable cut off points and the corresponding validity values for L-M score level in prediction of high risk (CS score >40) was shown in figure 2 and table 3,

cutoff L-M score level of 11.5 had acceptable validity results (90% sensitivity, 80% specificity, 91.9% PPV, 84.5% NPV and accuracy 86%). Figures 3 and 4 show CT images of 2 patients included in the study.
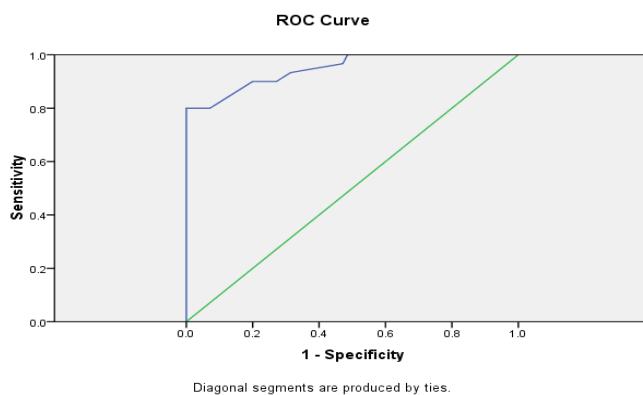

Figure 2: ROC for L-M prediction of high risk CS (AUC=0.94).

Table 3: ROC coordinates for prediction of high risk CS score by L-M.

| Cutoff point	Sensitivity	Specificity	PPV	NPV	Accuracy
8.5	93.3%	68.6%	88.8%	73.4%	81%
11.5	90%	80%	91.9%	84.5%	86%
12.5	80%	92.9%	82.2%	93%	84%
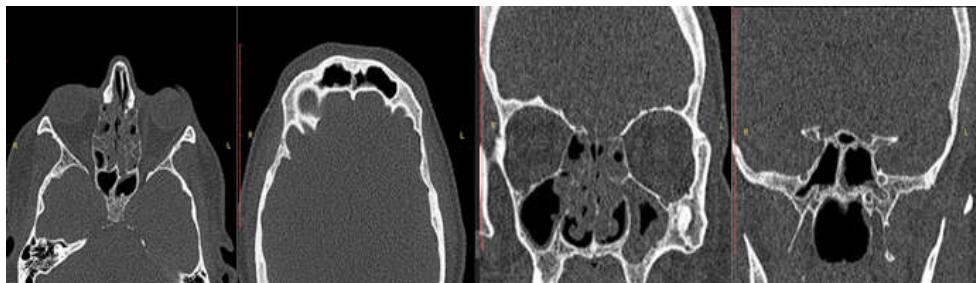
Figure 3: a 57 years old male patient, CS score 70, CT scan of PNS showed total opacification of both anterior and posterior air cells bilaterally (scored 2 on each side), partial opacification of bilateral maxillary, fontal and sphenoid sinuses (scored 1), total obliteration of both OMC (scored 2 for each), L-M score 18.

Figure 4: a 34 years old female patient presented with CRS, CS score 61, CT scan axial and coronal sections showing Rt. nasal deviation, total opacification of Rt. frontal sinus, bilateral anterior and posterior ethmoid air cells and Lt. sphenoid sinus (scored 2), partial opacification of both maxillary sinuses, Lt. frontal and Rt. sphenoid sinus (scored 1) ,obstructed both OMC (score 2 for each), L-M score 20

DISCUSSION:

Scoring of chronic rhinosinusitis is very important in screening and diagnosis this disease and it also improves the quality of care of patients in addition to cost benefits related lowering the costs of additional investigations [16].

Present study showed that Lund-Mackay CT scan score is correlated significantly with clinical symptoms score of chronic rhinosinusitis. This finding is consistent with results of Wabnitz et al [17] study in Australia which stated that symptoms scores of chronic rhinosinusitis is significantly correlated with disease severity as measured by Lund-Mackay CT scan score. Another study carried out by Garneau et al [18] study in USA on 55 adults found that modified Lund-Mackay CT scan score was the first imaging based score that correlates significantly with clinical symptoms score of chronic rhinosinusitis. Inconsistently, Rathor and Bhattacharjee in India [7] which revealed no significant correlation between clinical symptoms score and CT scan L-M score of chronic rhinosinusitis. Computerized tomography scanning is beneficial in diagnosis any anatomical abnormality or disease of paranasal sinus [19]. Additionally, it is effective in helping surgeons with surgical operations of skull base [20]. Indeed, current study findings are similar to results of many previously reported literature that found a significant correlation between clinical CRS symptoms and CT L-M score [17, 21]. On the other hand, many authors found no significant correlation between CT scan L-M score and chronic rhinosinusitis clinical symptoms score [22, 23]. This controversy between different literature leads to development of disease severity scoring for staging chronic rhinosinusitis in addition to clinical symptoms and CT scan L-M score. All these scores help the clinicians in diagnosis and planning for management [23].

The current study showed that mean L-M score was significantly higher among CRS patients with high risk of CS score (>40) (p<0.001). This finding coincides with the results of Geminiani et al [24] study in Brazil which found that L-M CT scan score is significantly predictable of nasal endoscopic findings of chronic rhinosinusitis and severity of clinical symptoms. However, Amodu et al [25] prospective study in Nigeria on 60 patients with chronic rhinosinusitis stated that CT scan L-M score is helpful in prediction of symptoms severity for nasal obstruction and discharge, but not for other clinical symptoms of chronic rhinosinusitis. In current study, L-M score of CT scan was significantly elevated for all complete opacification of right and left paranasal sinuses. These abnormalities were adopted by the Rhinosinusitis Task Force of the American Academy of Otolaryngology, Head and Neck Surgery (AAO-HNS) in diagnosis of chronic rhinosinusitis [26]. The chronic rhinosinusitis has a profound effect on quality of life [17]. For that, chronic rhinosinusitis must be reported as public health disorder with efforts in diagnosis and treatment [25].

This study showed that CT scan L-M score is significantly predictable for high risk (>40 CS score) chronic rhinosinusitis patients (p<0.001). This finding is similar to results of Amodu et al [25] study in Nigeria which stated that increased CT scan L-M score is indicator of severe stages of chronic rhinosinusitis as measured by clinical symptoms.

In the present study, the appropriate cutoff L-M score level of 11.5 had acceptable validity results in prediction of chronic rhinosinusitis (90% sensitivity, 80% specificity, 91.9% PPV, 84.5%

NPV and accuracy 86%). These findings are better than results of Leo et al [27] study in Italy which found that CT scan had sensitivity of 84.2% and specificity of 76.6% in diagnosis of chronic rhinosinusitis among children. Another study carried out in Poland by Frączek et al [4] reported an acceptable accuracy (88%) of CT scan L-M score in detection of chronic rhinosinusitis. The current study findings regarding accuracy of CT scan L-M score in diagnosis of chronic rhinosinusitis was close to results of Bhattacharyya et al [28] in USA which stated that the accuracy and positive predictive value of CT scan L-M score were increased for L-M more than 5.

The current study found that CT scan L-M score was significantly increased among younger age CRS patients (p=0.007). Consistently, Lim et al [29] study in USA reported that CT scan L-M score is significantly predictable for chronic rhinosisusitis severity and quality of life and this prediction is affected by age of patients. Our study also showed that mean CRS score also was significantly increased among younger age CRS patients (p<0.001). Similarly, Ebell et al [30] study in USA stated that clinical symptoms of chronic rhinosinusitis score had a higher accuracy in diagnosis of chronic rhinosinusitis among children. Present study found that both L-M and CRS scores were significantly higher among male CRS patients than female CRS patients (p=0.008, p<0.001, respectively). This finding agrees with results of Holme et al [31] study in Norway which revealed high predominance of male gender with chronic rhinosinusitis than females.

CONCLUSION:

The CT L-M score is positively correlated with clinical symptoms of CRS and is an acceptable predictable of chronic rhinosinusitis severity. It has a good validity finding in diagnosis of CRS. The CT L-M score is affected by age and gender of patients with CRS.

REFERENCES:

1. Caulley L, Thavorn K, Rudmik L. Direct costs of adult chronic rhinosinusitis by using 4 methods of estimation. J Allergy Clin Immunol. 2015; 136:1517-22.
2. Smith KA, Orlandi RR, Rudmik L. Cost of adult chronic rhinosinusitis: a systematic review. Laryngoscope 2015; 125:1547-56.
3. Brietzke SE, Shin JJ, Choi S. Clinical consensus statement: pediatric chronic rhinosinusitis. Otolaryngol Head Neck Surg 2014; 151:542-53.
4. Frączek M, Masalski M, Guziński M. Reliability of computed tomography scans in the diagnosis of chronic rhinosinusitis. Adv Clin Exp Med 2018; 27:541-45.
5. Fokkens WJ, Lund VJ, Mullol J, et al. European position paper on rhinosinusitis and nasal polyps 2012. Rhinol Suppl. 2012;3:1–298.
6. White PS, Maclennan AC, Connolly AA, Crowther J, Bingham BJ. Analysis of CT scanning referrals for chronic rhinosinusitis. J Laryngol Otol. 1996;110:641–43.
7. Rathor A, Bhattacharjee A. Clinical-radiological correlation and role of computed tomography staging in chronic rhinosinusitis. World J Otorhinolaryngol Head Neck Surg 2017; 3:169–75.
8. Miller JC. Imaging for Sinusitis. Radiology Rounds A Newsletter for Referring Physicians [6] Massachusetts General Hospital Department of Radiology. 2009;7.
9. Momeni AK, Roberts CC, Chew FS. Imaging of chronic and exotic sinonasal disease: [7] Review. AJR. 2007;189:S35-S45.
10. Rashmi Kandukuri , Suresh Phatak . Evaluation of Sinonasal Diseases by Computed Tomography. J Clin Diagn Res. . 2016;10:9-12.
11. Gotwald TF, Zinreich SJ, Corl F, Fishman EK. Three-dimensional volumetric display of [10] the nasal ostiomeatal channels and paranasal sinuses. AJR. 2001;176:241-45.
12. Chaitanya CS et al. Computed tomographic evaluation of diseases of paranasal [11] sinuses. International Journal of Recent Scientific Research. 2015;6:5081–86.
13. Lund VJ, Kennedy DW. Staging for rhinosinusitis. Otolaryngol Head Neck Surg. 1997;117:S35eS40.
14. Rosenfeld RM, Andes D, Bhattacharyya N, et al. Clinical practice guideline: adult sinusitis. Otolaryngol Head Neck Surg. 2007;137:S1eS31.
15. Lund VJ, Mackay IS. Staging in rhinosinusitus. Rhinology 1993; 31:183-84.
16. Ting F, Hopkins C. Outcome Measures in Chronic Rhinosinusitis. Curr Otorhinolaryngol Rep 2018; 6:271–75.
17. Wabnitz DA, Nair S, Wormald PJ. Correlation between preoperative symptom scores, quality-of-life questionnaires, and staging with computed tomography in patients with chronic rhinosinusitis. Am J Rhinol 2005; 19:91-96.

18. Garneau J, Ramirez M, Armato SG 3rd. Computer-assisted staging of chronic rhinosinusitis correlates with symptoms. Int Forum Allergy Rhinol 2015; 5:637–42.

19. Bhattacharyya N, Fried MP. The accuracy of computed tomography in the diagnosis of chronic rhinosinusitis. Laryngoscope 2003; 113(1):125–129.

20. Buljcik-Cupic MM, Savovic SN. Endonasal endoscopy and computerized tomography in diagnosis of the middle nasal meatus pathology. Med Pregl 2007; 60:327–32.

21. Arango P, Kountakis SE. Significance of computed tomography pathology in chronic rhinosinusitis. Laryngoscope 2001; 111:1779–82.

22. Basu S, Georgalas C, Kumar BN, Desai S. Correlation between symptoms and radiological findings in patients with chronic rhinosinusitis: an evaluation study using the Sinonasal Assessment Questionnaire and Lund-Mackay grading system. Eur Arch Otorhinolaryngol 2005; 262:751–54.

23. Holbrook EH, Brown CL, Lyden ER, Leopold DA. Lack of significant correlation between rhinosinusitis symptoms and specific regions of sinus computer tomography scans. Am J Rhinol 2005; 19:382–87.

24. Geminiani RJ, Vitale RF, Mazer AB, Gobbo HBC, Neto JJS, Lima JCB. Comparison between Computed Tomography Scan and Nasal Endoscopy in Diagnosis of Chronic Rhinosinusitis. Intl. Arch. Otorhinolaryngol São Paulo 2007; 11:402-5.

25. Amodu EJ, Fasunla AJ, Akano AO, Daud Olusesi A. Chronic rhinosinusitis: correlation of symptoms with computed tomography scan findings. Pan Afr Med J 2014;18:40.

26. Lanza DC, Kennedy DW. Adult rhinosinusitis defined. Otolaryngol Head Neck Surg 2000; 117:S1–S7.

27. Leo G, Incorvaia C, Masieri S, Triulzi F. Imaging criteria for diagnosis of chronic rhinosinusitis in children. Eur Ann Allergy Clin Immunol 2010; 42:199-204.

28. Bhattacharyya N, Jones DT, Hill M, Shapiro NL. The diagnostic accuracy of computed tomography in pediatric chronic rhinosinusitis. Arch Otolaryngol Head Neck Surg 2004; 130:1029-32.

29. Lim S, Ramirez MV, Garneau JC. Three-dimensional image analysis for staging chronic rhinosinusitis. Int Forum Allergy Rhinol. 2017; 7:1052–57.

30. Ebell MH, McKay B, Dale A, Guilbault R, Ermias Y. Accuracy of Signs and Symptoms for the Diagnosis of Acute Rhinosinusitis and Acute Bacterial Rhinosinusitis. Ann Fam Med 2019; 17: 164-172.

31. Holme SS, Moen JM, Kilian K, Haukeland H, Molberg Ø, Eggesbø HB. Development of CT-based methods for longitudinal analyses of paranasal sinus osteitis in granulomatosis with polyangiitis. BMC Med Imagin. g 2019; 19:13.

.