Available Online at http://www.recentscientific.com

ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 6, Issue, 7, pp.5081-5085, July, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

COMPUTED TOMOGRAPHIC EVALUATION OF DISEASES OF PARANASAL SINUSES

Chinnala Sai Chaitanya[1] and Atkuri Raviteja[2]

[1]Department of ENT, DY Patil Medical College & Hospital, Kolhapur, Maharashtra India
[2] Department of Radiodiagnosis ,Raja Muthaiah Medical College &Hospital, Chidambaram, Tamil Nadu, India

ARTICLE INFO

Article History:

Received 2nd, June, 2015
Received in revised form 10th, June, 2015
Accepted 4th, July, 2015
Published online 28th, July, 2015

Key words:

Computed tomography (CT), Paranasal sinus (PNS), Functional endoscopic sinus surgery (FESS).

ABSTRACT

Diseases of the paranasal sinuses include a wide spectrum of conditions ranging from inflammation to neoplasms, both benign and malignant. These sinuses are in close anatomical relationship with orbit, cranial fossa and pterygopalatine fossa. Hence early involvement of these areas is an important feature. CT imaging provides detailed information of the paranasal sinuses and is now well established as an alternative to standard radiographs. It is hospital based, prospective correlational descriptive clinic radiological study, 104 symptomatic paranasal sinus diseased patients were evaluated by clinical and CT (both axial and coronal sections) findings for the management of patients. All the patients underwent endoscopy or FESS following CT evaluation and findings were correlated.CT diagnosis had higher sensitivity, specificity, positive predictive value and negative predictive value in diagnosing anatomic variants of PNS, chronic sinusitis, sinonasal polyps, and other lesions in comparison to clinical diagnosis. However, sensitivity of CT was not so high in diagnosing fungal sinusitis as seen with other lesions. But involvement of the bone by PNS lesions was always demonstrated by the CT, which is the standard imaging modality to demonstrate it accurately.

INTRODUCTION

Diseases of the paranasal sinuses include wide spectrum ranging from inflammatory conditions to neoplasms, both benign and malignant. Plain film is inaccurate and inadequate in the diagnosis of non-neoplastic and neoplastic conditions of PNS. Imaging of the PNS has progressed from the realm of conventional radiographs (plain films) almost exclusively into the realms of computed tomography (CT) and magnetic resonance imaging (MRI). Technological advances in these two imaging modalities have provided more precise differential diagnosis and greater detail about the anatomic extent of the diseases of PNS. These provide sufficient information for diagnosis and surgical planning in the PNS diseases.

CT has replaced conventional radiographs as imaging modality of choice for assessment of PNS diseases. CT plays an important diagnostic role in patients with sinonasal disease and determines the treatment. CT is the imaging modality of choice since the advent of functional endoscopic sinus surgery (FESS). CT Plays an important role in the pre-operative evaluation of patients considered for FESS called SSCT (Screening sinus CT). It is now mandatory and a medico legal requirement to evaluate PNS and nose before FESS, as this provides a "ROAD MAP" to guide the otolaryngologist during surgery and serves to direct the surgical approach.

CT determines the distribution and extent of disease and detect those anatomic variations (like septal deviation, spur formation, concha bullosa, paradoxical curve of middle turbinate etc.) that may place the patients at increased risk for intra operative and post operative FESS complications and there by reduces the morbidity and mortality of patients. A combination of CT and diagnostic endoscopy has become the corner stone in evaluation of the paranasal sinus diseases. Hence CT has immense value and offers standard imaging of paranasal sinus diseases.

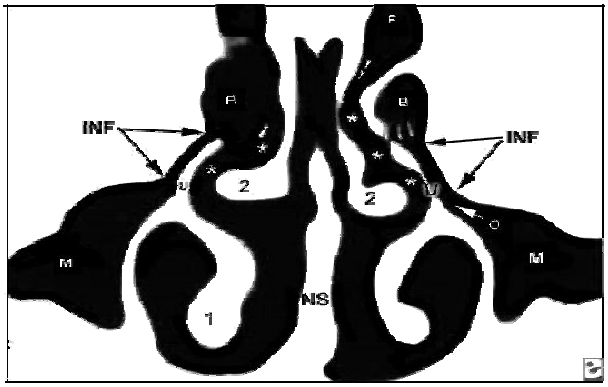


Fig 1 Osteomeatal Unit **:** 1. Inferior turbinate, 2. Middle turbinate, INF-Infundibulum, M-Maxillary Sinus, F-Frontal sinus, U-Uncinate process, B-Bulla ethmoidalis, O-Maxillary sinus ostium, * - Frontal recess

Corresponding author:* **Chinnala Sai Chaitanya
Department of ENT, DY Patil Medical College & Hospital, Kolhapur, Maharashtra India

Computerized tomographic findings

With reference to sinus secretions, watery and more acute secretions have a CT attenuation that is less than that of muscle but higher than that of fat. The Hounsfield units (HU) are usually in the range of 10-25, and this appearance is often referred to as water or mucoid attenuation. Once the secretions have become chronically thickened and concentrated, the CT attenuation rises to be equal to or slightly greater than that of muscle (30-60HU).

As per Glicklich *et al* graded the severity of sinus disease. As per this validated grading system it is classified as

Grade0: Less than 2 mm. mucosal thickening on any sinus wall.
Grade1: All unilateral disease or anatomic abnormalities.
Grade2: Bilateral disease limited to the ethmoid or Maxillary sinuses.
Grade3: Bilateral disease with involvement of at least one sphenoid or frontal sinus.
Grade4: Pan sinus disease.

Tasks force on Rhinosinusitis sanctioned by the American Academic of Otolaryngology used Lund - Mackay CT staging system by scoring method.

Five Major Recurring Patterns of inflammatory disease identified on CT[13]

Infundibular pattern (Fig 6)

This is the most limited of the obstructive pattern and is diagnosed when there is disease limited to maxillary sinus with obstruction visualized within the ipsilateral maxillary ostium and infundibulum. The osteomeatal unit is patent and there is no disease in the ipsilateral anterior ethmoid air cells and ipsilateral frontal sinus. The incidence being 26%. The causes are due to (a) Mucosal swelling at the infundibulum. (b) Polyps (c) anatomical variant such as Haller's cells (d) abnormally big uncinate process that encroach on infundibulum.

The Osteomeatal unit (OMU) pattern (Fig 2, Fig 3)

It is mainly causedby occlusion of the middle meatus. Ipsilateral frontal, anterior ethmoid, middle ethmoid and maxillary sinuses which drain through middle meatus will be involved. They all show inflammatory involvement. The OMU pattern may be full blown or partial. Any combination of involvement of frontal, maxillary, anterior and middle ethmoid sinuses is designated as OMU pattern. The lesion pre-disposed to obstruction are mucosal swelling, hypertrophied turbinates, polyps, adhesions, nasal tumors and anatomic variants like – concha bullosa, septal deviations, paradoxically curved middle turbinate. The incidence being 25%.

The Spheno- Ethmoidal Recess Pattern (Fig 4, Fig 5)

Inflammatory nasal pathology will lead to obstruction of the sinus ostia in the sphenoethmoidal recess (SER) with variable involvement of ipsilateral posterior ethmoidal and sphenoid sinuses. The incidence being 6%. It is mainly due to obstruction of the superior meatus anterior to Spheno – Ethmoidal Recess.

Sino nasal polyposis (SNP) (Fig 8, Fig 9)

It is an inflammatory condition leading to polypoid mucosa of the nose and para nasal sinuses. The SNP pattern of CT combines features of the 4 other pattern with additional features unique to SNP. At times it is aggressive and tendency to recur. Pathologically edematous hyperplastic heaped up in polypoid shape of mucosa observed.

The presence of thin hypodense mucosal rim differentiate it from malignancy. Secondary fungal infection in SNP is usually has no evidence of bony destruction, necrosis, vascular thrombosis and anatomical extension.

Sporadic or unclassified pattern

This includes retention cysts, mucoceles and mild mucoperiostial thickening.

MATERIALS AND METHODS

This study was a prospective study of 104 patients with disease of PNS, referred from Department of Otorhinolaryngology, Department of Head and Neck Surgery, Rajamuthaiah Medical college and Hospital, Chidambaram, TN with clinically suspected paranasal sinus diseases. This consisted prospective correlational descriptive clinical study of 104 patients with pathological lesions of paranasal sinuses between December 2013 to May 2015.

Patients presenting with history of headache, nasal obstruction, nasal discharge, anosmia, postnasal discharge, epistaxis. Clinically diagnosed / suspected sinusitis, benign / malignant neoplasms. and patients undergoing functional endoscopic sinus surgery (FESS) were included in this study

Both axial and coronal CT scan study (Done with GE, spiral CT machine) was done for 104 patients referred from Department of Otorhinolaryngology and Department of Head and Neck SurgeryRajamuthaiah Medical college and Hospital, Chidambaram, TN, with clinically suspected PNS diseases.

Informed consent obtained from the patient if i.v contrast was administered CT findings were entered in the proforma Lund Mackay scoring was done in case of inflammatory lesions After the CT PNS patients consent was taken for endoscopic sinus surgery Diagnostic nasal endoscopy was carried out in most of the cases under general anaesthesia. Endoscopic sinus surgery was tailored according to the CT scan was carried out mainly concentrating on sinus drainage, collection of mucopus, destruction of bones. Any polypoidal or mass lesions were debrided or biopsy taken for histopathological examination and fungal culture in selected cases. CT PNS findings were compared with endoscopic/ endoscopic sinus surgery findings. Statistical analysis was done using statistical software,

Microsoft Word and Excel have been used to generate graphs, tables etc.

Sensitivity and specificity of CT findings were calculated using endoscopic/ endoscopic sinus surgery findings as standard with reference to mucosal thickening, polypoidal/mass lesions, involvement of adjacent bones and soft tissue. Finally clinical diagnosis was correlated with CT diagnosis using Chi-square test.

RESULTS

A prospective corelational descriptive clinical study of 104 patients who underwent CT PNS was done and correlated with the final diagnosis after FESS and HPR.

Table 1 CT Severity Grading

CT Severity	Number (n=104)	Percentage
Grade 0	1	1.0
Grade 1	28	28.0
Grade 2	16	16.0
Grade 3	22	22.0
Grade 4	33	33.0

CT severity was assessed in 100 patients who had inflammatory sinus diseases. Maximum number of patients had grade 4 severity (33.0%) and grade 0 severity was found in least number of patients (1.0%).

Table 2 Endoscopy / FESS findings

Endoscopy	Number (n=104)	Percentage
Same as CT	99	95.2
Different from CT	5	4.8

Endoscopic / FESS findings were similar to CT findings in 99 (95.2%) patients and different from CT findings in 5 (4.8%) patients. These different findings were related to either fungal disease or inspissated secretions.

Table 3 Comparison of findings of Clinical, CT and final diagnosis

Findings	Clinical		CT		Final diagnosis	
	No	%	No	%	No	%
Chronic Sinusitis	89	85.6	55	52.9	54	51.9
Polyp	9	8.7	32	30.8	32	30.8
Fungal sinusitis	1	1.0	7	6.7	8	7.7
Others	5	4.8	10	9.6	10	9.6

Best comparison observed between CT and final diagnosis but poor comparison between clinical and final diagnosis

Table 4 Sinus involvement

Sinus	17	18	Present Study
	Kelkar AA	Dua K	
Maxillary	58%	50%	88.5%
Ant.Ethmoid	60%	88%	78.8%
Post.Ethmoid	23%	66%	69.2%
Frontal	43%	32%	52.9%
Sphenoid	31%	18%	42.3%

Most common sinus involved was maxillary sinus in 92 p a ti e nt s (88.5%), followed by anterior ethmoid (78.8%), posterior ethmoid (69.2%), frontal (52.9%) and sphenoid sinuses (42.3%) in decreasing order. Studies in literature observed[16] [15] involvement of anterior ethmoid sinus and maxillary sinus more common.

Present study correlates well with later study, where the number of patients studied are more than 100 and all patients underwent FESS. But in the former study 60 patients were studied but there is no mention of whether all patients underwent FESS or not. In all the studies sphenoid was least involved, which is also observed in this study. Sinonasal polyposis was the most common type of pattern involved, followed by osteomeatal unit, infundibular, sphenoethmoid recess and sporadic patterns in decreasing order of involvement.

The CT severity assessed for 100 patients with inflammatory diseases showed highest no of patients of grade 4- 33 (33%) patients and lowest of grade I- 1 (1%) patient. Lund MacKay scoring between 16-20 was observed in more number of patients 25 (24.1%). The mean score observed was 12.37 ± 6.92.

Table 5 Fungal sinusitis

Aher AR[17]	Prabhakar S[15]	Present Study
6%	9.3%	7.7%

Greatest pitfall in diagnosis of PNS diseases by CT is the fungal sinusitis. In this study 8 patients were studied among which 5 (62.5%) were diagnosed correctly and others were not diagnosed on CT. The sensitivity was 62.5% and specificity was 97.9% for CT to diagnose fungal sinusitis. The sensitivity described in literature was 76% by Zenreich SJ *et al*, which was a retrospective study. False positives are observed as the density increase is also seen in inspissated secretion, calcification in bacterial infections etc. False negatives are observed, as there will be no increase in density in some cases. But CT plays important role in diagnosing invasiveness of fungal sinusitis like spread to adjacent structures, bone erosion or destruction.

DISCUSSION

CT has the capability to delineate the bone erosion or destruction with the highest accuracy in the imaging modalities. In this study CT detected the bone erosion or destruction in all the 7 patients, which was confirmed on endoscopy/FESS. The sensitivity and specificity of CT to detect bone erosion or destruction was 100% where as clinical detection had 14.3% sensitivity and 100% specificity. This is where the CT has definite advantage over the MRI. When malignant mass causing bone destruction, CT and MRI can be used as complimentory to each other without the bias to one modality.

Endoscopic findings were almost all correlated with CT findings except in fungal sinusitis. The findings of CT were similar to endoscopy/FESS findings in 99(95.2%) of patients and different in 5(4.8%) patients. All the false positive or false negatives are related to fungal sinusitis. Except the fungal sinusitis, sensitivity and specificity of CT was almost 100%.

Clinical, CT and Final diagnosis

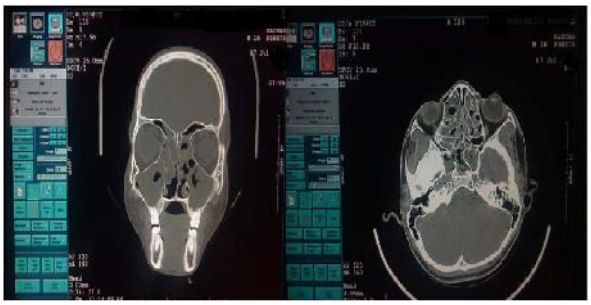
When the comparison table is viewed there is a best correlation between the CT diagnosis and final diagnosis but poor correlation between the clinical diagnosis and final diagnosis.

On correlating clinical diagnosis with final diagnosis, chronic sinusitis has 100% sensitivity but only 30% specificity with accuracy of 66.4%. Polyps has sensitivity of 25% and specificity of 98.6%. For fungal sinusitis the sensitivity was only 12.5%, which was very poor. In diagnosing benign and malignant lesions of PNS was also difficult which had sensitivity of only 50%.

On correlating CT diagnosis with final diagnosis, chronic sinusitis has 98.2% sensitivity and 96% specificity. Polyps have sensitivity of 96.9% and specificity of 98.6%. Again for fungal sinusitis CT has lower sensitivity of 62.5% and specificity of 97.9%. For diagnosing benign and malignant lesions CT has 100% sensitivity, specificity, positive predictive value and negative predictive value with 100% accuracy. P value in all instances was < 0.05 i.e. <0.01, indicating the significance of the findings. This high sensitivity and specificity for benign and malignant masses could be due to small number of masses evaluated.

Thus, CT plays an important role in diagnosing and also adding important findings for the better management of the patients with paranasal sinus diseases.

Chronic Sinusitis – Pattern Of Involvement



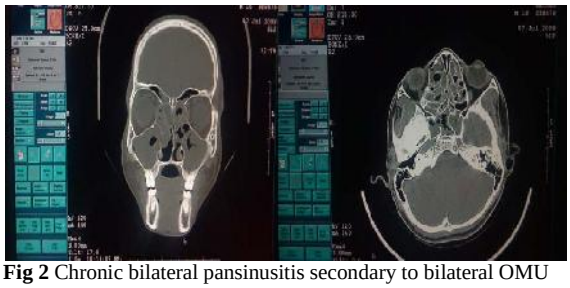


Fig 2 Chronic bilateral pansinusitis secondary to bilateral OMU Obstruction

Fig 3 Chronic bilateral pansinusitis secondary to bilateral OMU pattern of Obstruction

Fig 4 Chronic bilateral pansinusitis secondary to OMU and SER Pattern of Obstruction

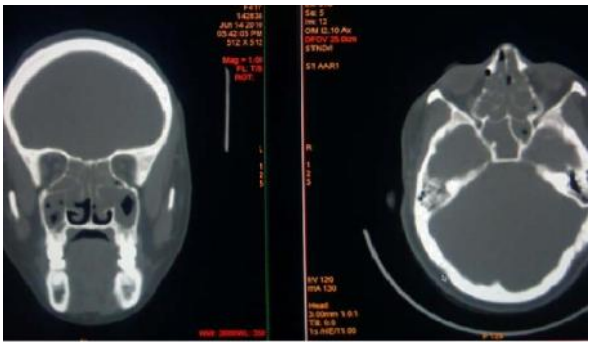


Fig 5 Bilateral pansinusitis secondary to bilateral OMU and SER Pattern of Obstruction

Fig 6 Both maxillary sinuses show extensive mucosal thickening with opacification secondary to Infundibular Pattern of Obstruction

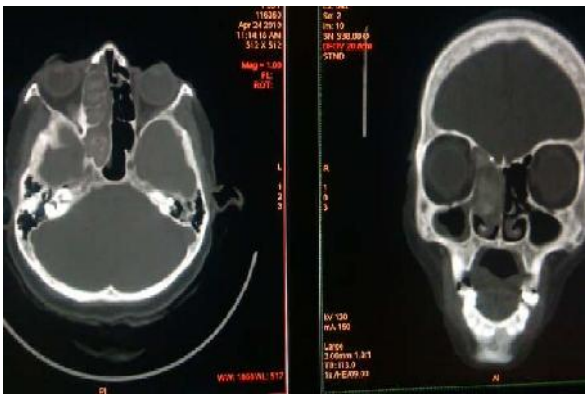


Fig 7 (a) Soft tissue attenuating lesion occupying the right maxillary and right ethmoid sinus with central hyperattenuating areas seen. (b) Ballooning of lamina papyracea seen secondary to mass effect with Right orbital proptosis with preseptal swelling seen – CT Features are typical of FUNGAL SINUSITIS

Sinonasal Polyposis Pattern

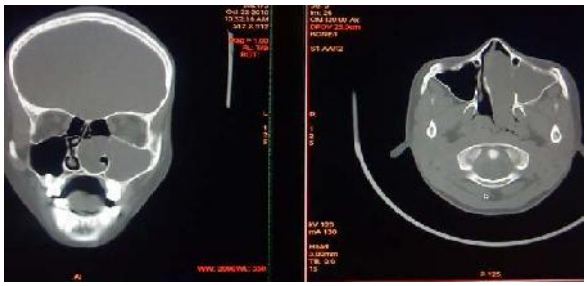


Fig 8 Left Antrochoanal Polyp with nasopharyngeal extension , DNS towards right is also seen

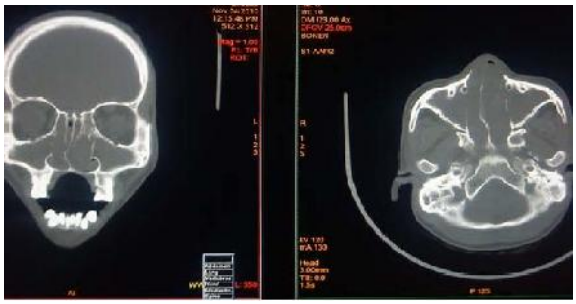


Fig 9 Bilateral Extensive Sinonasal Polyposis with nasopharyngeal extension

Summary

- CT is the modality of choice to assess the clinically relevant anatomic variations of sinonasal region.
- CT is the modality of choice in imaging the paranasal sinuses for evaluating the chronic diseases and associated complications.
- Fungal sinusitis and dense secretions are potential pitfall on CT to differentiate them. But CT may suggest fungal sinusitis in whom it is not suspected.
- CT is the modality of choice in evaluating the bone erosion or destruction.
- CT evaluation of PNS in symptomatic patients helps in planning the further management of the patient.
- CT helps in staging the PNS disease and its extension and involvement of surrounding structures.

However, CT has certain potential drawbacks and disadvantages like complex projections, artifacts induced by very high density structures in and around PNS, by the patient movement, limited soft tissue resolution. Even radiation exposure in CT examination limits frequent usage, test repeatability and its use in children and pregnant women.

For these reasons, MRI is taking an increasingly important role in many of these areas. The soft tissue contrast discrimination is greater than with CT images, with an equivalent spatial resolution. Further advantages of MRI include the ability to image in any plane without loss of spatial resolution, the ability to demonstrate vessels without the need for contrast medium, no ionizing radiation, and the relative freedom from artifacts compared with CT. Both CT and MRI with their unique features for better depiction bone details and soft tissue details respectively, carry their own importance and play a complimentary role to each other in identifying the pathological conditions of paranasal sinuses.

BIBLIOGRAPHY

1. Aher AR, Gujarathi UP, Shinde KJ. Incidence of fungal infections in Chronic maxillary sinusitis. Indian Journal of Otolaryngology and Head and Neck surgery Apr-June 2000; 52(2):122-124.
2. Asruddin, Yadav SPS, Yadav RK, Singh J. Low dose CT in chronic sinusitis. Indian Journal of Otolaryngology and Head and Neck surgery Dec 1999-Mar 2000;52(1):17-22.
3. Aygun N and Zinreich SJ. Imaging for functional endoscopic sinus surgery. OCNA 2006; 39:403-416.
4. Babbel RW, Hamsberger HR. A Contemporary look at the imaging issues of the sinusitis: Sinonasal anatomy, physiology and CT techniques. Seminars in ultrasound, CT and MRI 1991; 112:526-540.
5. BD chaurasia's Human Anatomy. Regional and applied dissection and clinical. Volume 3. Head, Neck and Brain. 4th edn 2006; CBS publishers and distributors: 227-238.
6. Branstetter BF and Weissman JL. Role of MR and CT in the paranasal sinuses. OCNA 2005; 38:1279-1299.
7. Dua K, Chopra H, Khurana AS, Munjal M.CT scan variations in chronic sinusitis. IJRI 2000; 15(3):315-320.
8. H. Chopra; Nasal Polyps: A clinical, histopathological and radiological profile. Indian J. Otolaryngol. Head and Neck Surg. (April-June 2008) 60, 112-116.
9. Hansberger HR, Osborn AG, Smoker WRK. CT in the evaluation of the normal and diseases of paranasal sinuses. Seminars in ultrasound, CT, MR 1986; 7:68-90.
10. Jaluskar SK, Patil NP. Value of CT in the evaluation of the chronic sinus diseases. Ind JLO Head and Neck surgery Dec 1992; 4:188-192.
11. Jaswal A. *et.al.*,; Paranasal sinus mucoceles : a comprehensive retrospective study in indian perspective. Indian J. Otolaryngol. Head Neck Surg. (April-June 2008) 60, 117-122.
12. Kelkar AA, Shetty DD, Rahalkar MD, Pande SA. Space occupying lesions of paranasal sinuses- A CT study. IJRI 1991; 1(Nov):47-50.
13. Lund VJ, Lloyd DS, Lloyd G. Imaging for endoscopic sinus surgery in adults JLO 2000; 114: 395-397
14. Maru YK, Gupta Y. Concha bullosa: Frequency and appearances on sinonasal CT. Indian Journal of Otolaryngology and Head and Neck surgery Dec 1999-Mar 2000; 52(1):40-44.
15. NarayanaSwamy KV, ChandreGowda BV. A clinical study of benign tumours of nose and paranasal sinuses. Indian Journal of Otolaryngology and Head and Neck surgery Oct- Dec 2004; 56(4):265-268.
16. Prabhakar S, Mehra YN, Talwar P, Mann SBS, Mehta SK. Fungal infections in maxillary sinusitis. Indian Journal of Otolaryngology and Head and Neck June 1992; 1(2):54-58.
17. Shroff MM, Shetty PG, Navani SB, Kirtane MV. Coronal screening sinus CT in inflammatory sino-nasal disease. IJRI 1996; 6:3-17.
18. Singh IB, Pal GP. Human embryology 7th Edn 2003; MacMillan India Ltd: 144-146.