RESEARCH PAPER | Medical Science | Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

# Risks During Surgeries and Predisposition to Pathologies Due to Normal Variants in Paranasal Sinuses

KEYWORDS


| Dr. Deeksha Seth | Dr. Anees Dudekula |
|---|---|
| Department of Radiodiagnosis , Kasturba Medical College and other affiliated hospitals, Manipal University , Mangalore. | Department of Radiodiagnosis , Kasturba Medical College and other affiliated hospitals, Manipal University , Mangalore. |
| **Dr Ashwini Kumar** | **Dr Anand Venugopal** |
| Department of Radiodiagnosis , Kasturba Medical College and other affiliated hospitals, Manipal University , Mangalore. | Department of Radiodiagnosis , Kasturba Medical College and other affiliated hospitals, Manipal University , Mangalore. |
| **Dr Vinaya Poornima** | **Dr Sonali D Prabhu** |
| Department of Radiodiagnosis , Kasturba Medical College and other affiliated hospitals, Manipal University , Mangalore. | Department of Radiodiagnosis , Kasturba Medical College and other affiliated hospitals, Manipal University , Mangalore. |


**INTRODUCTION**

During fetal development, the paranasal sinuses originate as invagination of the nasal mucosa into the lateral nasal wall, frontal, ethmoid, maxilla and the sphenoid bones. This unique development explains the enormous amount of anatomical variation. Computed tomography (CT) is an excellent means of providing anatomical information of this region, assessing disease extent, assisting endoscopic evaluation and guiding treatment.1 Computed tomographic (CT) scanning of the face has become a standard part of oromaxillofacial imaging.

Agger nasi cells, Haller cell (Figure 1), septal deviation (Figure 2,3), concha bullosa (Figure4),

paradoxical middle turbinate (Figure 5,6), and Onodi cell (Figure 7) are the anatomic variants of paranasal sinuses.2 Variations in paranasal sinus anatomy as shown on CT scans is of potential significance, for it may pose risks during surgery or predispose to certain pathologic conditions and diseases.3

Studying the relative frequency and concurrence of these variations in a given population, and comparing the results with that of other races may yield important hints in medical decision-making and surgical planning for all patients.4 The same diagnostic image can simultaneously be used to accurately determine the distance between the alveolar ridge and maxillary sinus floor, which in turn shall serve as a template for bone grafting and implant surgery at this location.

Detailed knowledge of anatomic variations in paranasal sinus region is critical for surgeons performing endoscopic sinus surgery as well as for the radiologist involved in the preoperative work-up.5 Some anatomical variations may predispose to sinusal diseases, constituting areas of high risk for injuries and complications during surgical procedures. Therefore, the recognition of such variations is critical in the preoperative evaluation for endoscopic surgery. Considering the wide range of variations in the anatomy, each and every para-nasal sinus case should be planned individually and carefully to avoid dreadful complications and maximise patients' benefit.6 The difference of anatomic landmarks during endoscopic surgery can result in bony

transgression and increase the difficulties of the surgery. In fact, functional endoscopic surgery is a blind surgery leading to severe complications with medico-legal impact.

Therefore, the anatomic sinonasal variations should be depicted in all sino-nasal CT imaging studies irrespective of the indications. Moreover, some anatomical variants may cause certain symptoms.7 It is assumed that these anatomic variants contribute to chronic sinusitis by blocking normal sinus drainage.8 Endoscopic endonasal surgeries are being performed in children. Therefore, we need to know the precise anatomy and anatomic variations of the paranasal sinuses and nasal wall. This is important in order to achieve better surgical results and avoid complications.

Due to the absence of a definitive relationship between the anatomic variations and sinus disease, aggressive surgical interventions should be avoided while performing endonasal endoscopic surgery in the children.9 Also, functional endoscopic sinus surgery (FESS) for children has come up where knowledge of the anatmy and variants of the paranasal sinuses is important so that children can have better improved life. Thus, it is essential to know the precise anatomy and anatomical variations of the nose, as well as the relationship between such anatomy and chronic sinusitis in all the age groups.10

**AIMS AND OBJECTIVES:**

Aim: To find the common anatomic variants of the paranasal sinuses and the strength between variants and the different form of sinusitis and sinusal diseases.

**Objectives:**

1.To find out the frequency and types of anatomic varia-

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

tions in the paranasal sinuses on CT Scan.
2. To find out which anatomical variations may predispose to sinusal diseases.
3. To find out gender and age differences in these anatomic variants.
4. To list complications due to the sinus surgery.

**MATERIAL AND METHODS:**
Type of Study and Study Design: Cross-Sectional Study.

The study made use of the Computed Tomography (CT) Scan Machine in the study population to find out the objectives. GE Hi Speed DX/i Single Slice Spinal CT was used. Patient was positioned in prone position with extension of head. 2 mm contiguous slices were taken with reconstitution at 140 kV and 150mA. The information about age, gender, mode of CT scan (coronal or axial), imaging evidences of inflammatory disease for each sinus, paranasal anatomic variants, types of sinusitis present and any other disease of the osteo-meatal complex were recorded.

Study Population: Patients coming to the Radiology Department of KMC Hospital, Attavar, Mangalore with CT scan to be done of the Osteo-meatal complex.

Sample Size: The sample size was selected in accordance with the Biostatistics. With 95% confidence interval and 85%power and p= 56.7, the sample size comes to be is 130.

**Selection Criteria:**
**Inclusion Criteria:**
1. Patients of all the age groups were considered for this study.
2. Both males and females.
3. Patients who give consent.

**Exclusion Criteria:**
1. Patients with cases of nasopharyngeal tumors, gross mucosal hypertrophy, previous surgery of the face, and disfigurement of the face due to trauma were considered due to distortion of the regional anatomy.
2. Patients who do not give consent.

Place of Study: The study was conducted in the Radiology Department of Kasturba

Medical College Hospital, Attavar in Mangalore. The study was conducted under the Department of Radiodiagnosis in collaboration with the departments of ENT.

Duration of Study: 2months for data collection and 1month for evaluation. Statistical Analysis: Data analysis was done using SPSS 16.0. Chi-s ua e test and Fishe 's test were used to analyse the data.

Ethical Considerations: Ethical consideration has been taken from the Institutional Ethical committee of Kasturba Medical College, Mangalore. The form is attached with the documents.

**RESULTS :**
A total of 130 patients were analyzed for the study. Out of which 54.6% (71) were males and 45.4% (59) were females. The mean age of the patients was 32.4±14.9years. Out of 130 patients who visited the hospital for CT Scan, anatomical variants were found to be present in 88.4% (115/130) patients and was absent in the rest 11.5% (15/130) patients. Theyoungest patient was 6 years while the eldest patient was 74 years old.

| S.no | Anatomical Variants (N=115) | Present | Absent |
|---|---|---|---|
| 1 | Agger nasi cells | 0 (0%) | 115 (100%) |
| 2 | Deviated nasal Septum | 74 (64.3%) | 41 (35.6%) |
| 3 | Concha Bullosa | 36 (31.3%) | 79 (68.6%) |
| 4 | Haller cells | 7 (6.1%) | 108 (93.9%) |
| 5 | Paradoxical Middle Turbinate | 5 (4.4%) | 110 (95.6%) |
| 6 | Onodi cells | 18 (15.6%) | 97 (84.3%) |
| 7 | Bulla ethmoidalis | 0 (0%) | 115 (100%) |

**Table 4 : Types and frequency of anatomical variants found in the study.**

| S.no | Types of Sinusitis | Anatomical Variant present N=(115/130) | | Anatomical Variant absent N=(15/130) | |
|---|---|---|---|---|---|
| | | Present | Absent | Present | Absent |
| 1 | Maxillary Sinusitis | 12 (10.3%) | 103 (88.8%) | 1 (6.6%) | 14 (93.3%) |
| 2 | Frontal Sinusitis | 7 (6.1%) | 108 (93.9%) | 1 (6.6%) | 14 (93.3%) |
| 3 | Ethmoidal Sinusitis | 8 (6.9%) | 107 (92.2%) | 1 (6.6%) | 14 (93.3%) |
| 4 | Sphenoid Sinusitis | 2 (1.7%) | 113 (98.3%) | 0 (0%) | 15 (100%) |
| 5 | Pansinusitis (+3) | 9 (7.8%) | 106 (92.1%) | 0 (0%) | 15 (100%) |

**Table 5: Types and frequency of sinusitis found in the study**

| S.no | Anatomic Variants | Maxillary | Frontal | Ethmoidal | Sphenoidal | Pansinusitis |
|---|---|---|---|---|---|---|
| 1 | Deviated nasal Septum (DNS) | 0.1 | 0.02 | -0.06 | -0.12 | 0.08 |
| 2 | Concha Bullosa | 0.05 | 0.01 | 0.0 | 0.15 | 0.04 |
| 3 | Haller cells | 0.01 | 0.00 | 0.01 | 0.00 | -0.01 |
| 4 | Paradoxical Middle Turbinate | 0.0 | 0.01 | 0.0 | 0.0 | 0.0 |
| 5 | Onodi cells | 0.05 | 0.08 | 0.05 | 0.0 | -0.04 |

**Table 3 :Correlation of different variants and types of sinusitis.**

**DISCUSSION:**
Humans have four pairs of sinuses named by the bones of the skull that they pneumatize. The maxillary, ethmoid (divided into anterior and posterior cells) frontal and sphenoid sinuses. These are lined by mucosa. Sinusitis is defined as an inflammatory process involving the mucus membrane of the paranasal sinuses and/or the bone. Chronic rhinosinusitis is one of the most common illnesses of our times and is a condition that is increasing in epidemic proportions throughout the world.1 CT scan of the paranasal sinuses is done in the setting of chronic rhinosinusitis by rhinologists as confirmation of sinusitis on many occasions, though it is mandatory as a prerequisite for endoscopic sinus surgery. CT demonstrates both the extent of disease and any anatomical variations that may predispose to rhinosinusitis. It delineates adjacent vital structures so that iatrogenic damage can be avoided. There are also many clinically significant variations of the paranasal sinuses which contribute to the etiology and pathology of sinusitis.[25]

A total of 130 patients were analyzed for the study. Out of which 54.6% (71) were males and 45.4% (59) were females. The mean age of the patients was 32.4±14.9years. Out of 130 patients who visited the hospital for CT Scan, anatomical variants were found to be present in 88.4% (115/130) patients and was absent in the rest 11.5% (15/130) patients. The youngest patient was 6 years while the eldest patient was 74years old. Maximum patients were seen in the age group of 21-40 years followed by 41-60 years and there was not much difference between the number of females and males in both the groups. Males in the younger age group were more affected than the females.

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

Out of 130 patients who came for CT scan of the Osteomeatal complex (OMC), 115 (88.4%) were found to have anatomic variants. 93% of the total males and 83.1% of the total females were found to have anatomic variants out of the 130 patients. Out of these 115 patients who had anatomic variants, 66 (57.4%) were males and 49 (42.6%) were females. 61-80 years age group showed maximum of number of patients with anatomical variants (100%) followed by 21-40 (94.5%). 75% of the patients in the younger age group (1-20) years had anatomic variants which was least among all the age groups.

The most common anatomical variant was deviated nasal septum (64.3%) followed by concha bullosa (31.3%). DNS 64.43% > Concha Bullosa 31.3% > Onodi cells 15.6% > Hallar cells 6.1% > Paradoxical middle turbinate 4.4% > agger nasi cells = bulla ethmoidalis 0% each. Agger nasi cells and bulla ethmoidalis were not found in any of the patients. A study showed the frequency of anatomical variants as the septal deviation (34.24%) was the most common normal variation and the other cases were sequentially as follow:1- Agger Nasi cell (36.22%), 2- Concha bullosa (15.90%), 3- Hypoplastic frontal sinus (6.24%), 4- Aerated Septum (2.62%), 5- Haller cell (1.41%), 6- Onodi cell (0.40%).[24] Another study done in Muscat showed agger nasi cells to be the most common anatomic variant. [25] The reported prevalence of the agger nasi cell varies widely among investigators. In anatomic dissection, Messerklinger encountered the agger nasi cell in 10- 15% of specimens. Kantarci et al. , however, noted this cell in 47% of specimens, while Krzeski reported its presence in 52.9% of cases and Van Alyea in 89% of individuals. Kennedy and Zinreich noted the presence of the agger nasi cell in nearly all patients evaluated.[19,21,25] Similarly, Bolger et al. reported that it was present in 98.5% of casesNouraei et al. in their study of 278 CT scans shown concha bullosa in 35% patients. Our study also showed similar results (31.3%).[26]

The most common sinusitis by which people were affected were maxillary sinusitis (10.3%) followed by pansinusitis (7.8%) in patients with anatomical variants. The least troublesome sinusitis was sphenoid sinusitis (1.7%). Sinusitis was also seen in patients without anatomic variants. Maxillary, frontal and ethmoidal sinusitis was present in patients without any presence of anatomic variations (6.6%). 33% (38/115) developed sinusitis in the presence of anatomical variants and 20% (3/15) developed sinusitis without any anatomical variants. It can be said that anatomical variants are associated with the occurrence of sinusitis. Significant relation of presence of anatomical variant and presence of sinusitis was found to be ($p<0.003$). Other way significance between the absence of anatomical variant and presence of sinusitis came out to be ($p<0.02$).

DNS shows positive relation with maxillary, frontal and pansinusitis while negative relation with ethmoidal and sphenoidal sinusitis. Concha bullosa shows no relation with ethmoidal sinusitis while a positive relation with maxillary, frontal, shenoidal and pansinusitis. Hallar cells show a positive relation with only maxillary sinusitis. Paradoxical middle turbinate shows positive relation with only frontal sinusitis. Onodi cells show a negative relationship with pansinusitis and no relation with sphenoid sinusitis.

Out of 74 patients with DNS, only 8 (10.8%) developed maxillary sinusitis ($p=0.02$), 5 (6.8%) patients developed ethmoid sinusitis ($p=0.05$), 6 (8.2%) developed frontal sinusitis ($p=0.03$), 1(1.4%) developed sphenoid sinusitis ($p=0.02$) and 7 (9.5%) developed pansinusitis ($p=0.02$). 47 patients (63.5%) did not develop sinusitis because of DNS. Out of 7 patients with hallar cell as anatomic variant, 1 developed maxillary sinusitis ($p=0.0$) and pansinusitis ($p=0.02$), none of them developed ethmoid, sphenoid and frontal sinusitis ($p=0.0$). 5 patients (71.4%) did not develop sinusitis because of hallar cells.Out of 36 patients with concha bullosa, 4 developed maxillary sinusitis ($p=0.01$), 1 developed ethmoid, frontal ($p=0.01$) and pansinusitis ($p=0.02$) and no cases of sphenoid sinusitis ($p=0.0$). In presence of Onodi cells as variant, 1 patient was found to have frontal sinusitis ($p=0.2$).

Polypoidal mucosal thickening was present in 13.9% (16/116) patients with anatomical variants ($p=0.04$). 32.2% (38/115) patients had more than 1 anatomic variant. 5 patients with DNS also had hallar cell as the second anatomic variant. 21 patients with DNS had concha bullosa as the second most common anatomic variant. Left sided septal deviation was related to the left side concha bullosa ($p <0.002$). Our results were different form the study which showed strong association between the existence of Concha bullosa and septal deviation in the opposite directions (P-value <0.00113).[24] 13 patients with DNS had also onodi cells as the anatomic variant. The least common anatomic variant co-existent with DNS was paradoxical middle turbinate (2 patients).

Left sided septal deviation was the most common anatomic variant (32.4%). Right sided concha bullosa was found in least numbers. Onodi cells were more common on the right. Paradoxical middle turbinate was least on the left compared to the bilateral and the right.

Association of DNS with maxillary sinusitis was observed ($p=0.03$). Concha bullosa with maxillary sinusitis association ($p=0.04$) and with ethmoid sinusitis ($p=0.03$). While sphenoid and frontal sinusitis showed ($p=0.01$) association with concha bullosa. Hallar cells showed association with maxillary sinusitis ($p=0.01$).

Out of 115 patients with anatomic variants, 26 (22.4%) patients belonged to the in-patient departments while 89 (76.7%) belonged to the out-patient department. Out of 115 patients with anatomic variants, 38 patients (33%) had sinusitis and 77 (67%) did not develop sinusitis. 3/15 (20%) patients who did not have any anatomic variants also developed sinusitis while 12/15 (80%) did not. Anatomic variants play a role in the development of sinusitis. Out of the33 patients with sinusal diseases, 27 patients (81%) underwent surgery. Lamellar air cells, Patent ostia of omc, polyp in right maxillary sinus, left maxillary sinus septation, sino-nasal polyposis, chronic sinusitis, extensive sinonasal polyposis, mucocele, adenoid hypertrophy, pneumatisation of crista galli, B/L fronto ethmoidal polyposis were some of the sinusaldiseases found in the patients with anatomic variants. 9 patients (33.4%) who underwent surgery developed complications like hemorrhage, CSF leak, Anosmia, adhesions, post-op rhinitis and post-op epistaxis.

**CONCLUSION:**

It was found that osteo-meatal complex diseases were common more on males than females. The mean age of the patients was 32.4 years and the most patients belonged to the age group of 21-40 years. 88% of the patients were found to have anatomical variants of the paranasal sinuses. Anatomic variants were less common in females. The anatomical variants were less common in

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

the younger age group till 20 years of age as compared to the elderly age group 21-60 years. Left sided deviated nasal septum was the most common anatomical variant followed by left sided concha bullosa and right sided onodi cells. Agger nasi cell, bulla ethmoidalis and uncinated process variants were not found in any of the patients. Study concluded a positive relation between left sided deviated nasal septum and left sided concha bullosa. The most common sinusitis was maxillary sinusitis and pansinusitis. Sinusitis was more prevalent in patients with anatomical variants. 81% patients with chronic sinusitis and pathologies due to anatomic variants underwent sinus surgery and 33.4% out of these developed complications after the surgery.


Figure 1 : Right Haller cell

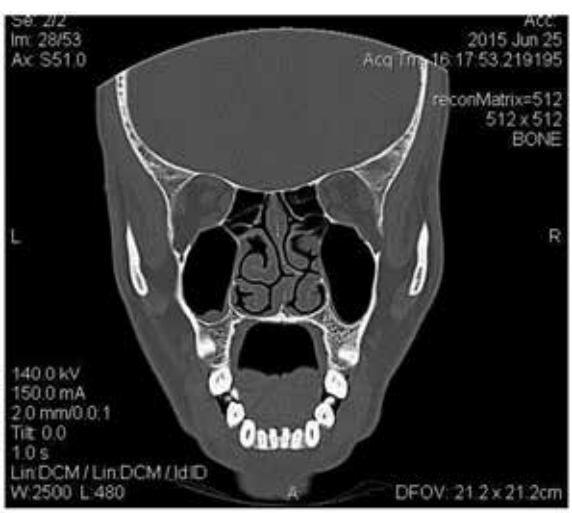


Figure 2 : DNS to right

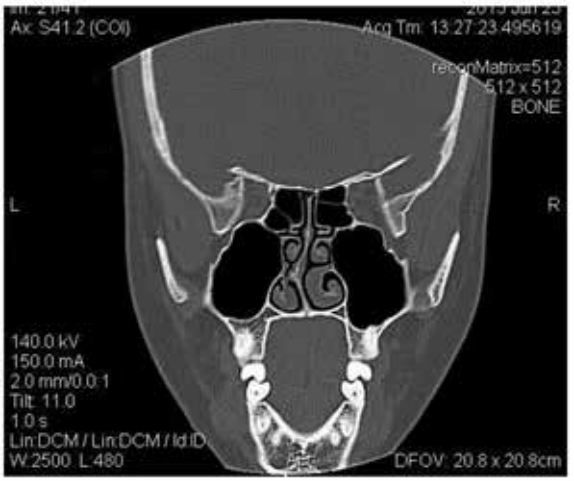


Figure 3 : DNS to left

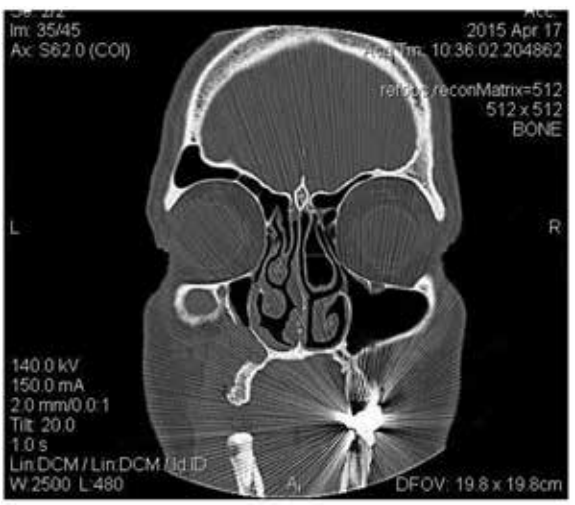


Figure 4 : Right concha bullosa

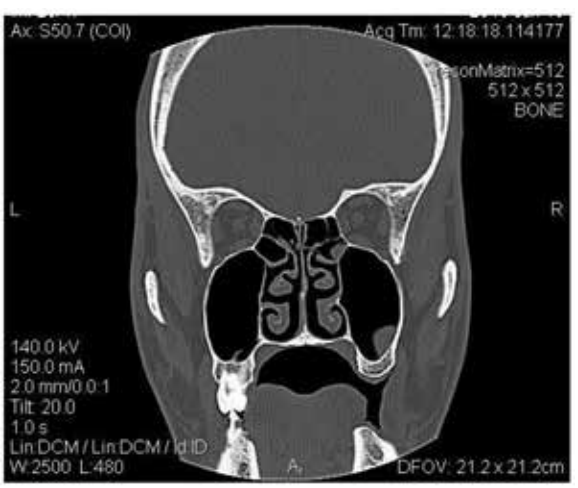


Figure 5 : Bilateral paradoxical turbinate.

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

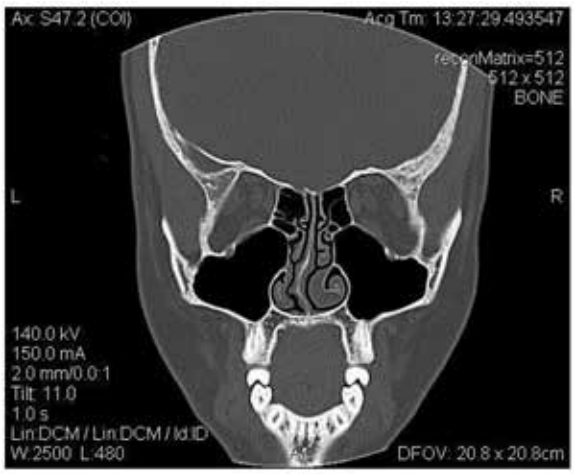


Figure 6 : paradoxical right middle turbinate with DNS to left.

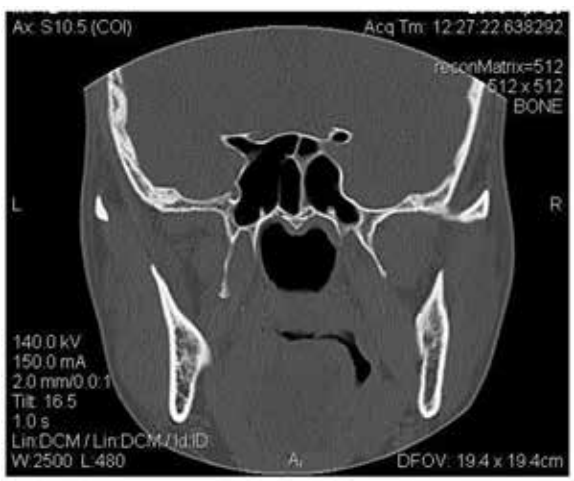


Figure 7 : Left onodi cell.

**REFERENCE** R.S.N. Pillai, Bagavathi. "Management Accounting" (2005)3rd Edition S Chand Publication, New Delhi:262-263. | Dinesh Patel. "Financial Analysis- A Study of Cement Industries in India", 1992 (A Thesis submitted to VNSGU, Surat)/Jayesh Patel "Finacial Analysis- A case Study of Sugar Factory in Valsad and Navsari District", 2002 (A Thesis submitted to VNSGU, Surat)/Girish Ved "Study on Financial Statements and Its Evaluation at Gujarat Co-Operative Milk marketing Federation, Anand", 2003-04 (A Thesis submitted to VNSGU, Surat) /Hemal Pandya, ChetanaParmar.(2014). Profitability Analysis of Selected Nationalized Banks in India. GRA-Global Research Analysis (3):10-14/BhavsinhDodiya. (2014). Acomparative Study on Cash Flow Statement of ICICI Bank and Axis Bank.Indian Journal of Applied Research (4): 66-68/www.welspun.com/www.ghcl.com