

# Positive Predictive Value of X-Ray PNS 45<sup>0</sup> in Chronic Maxillary Sinusitis Taking Antral Washout as Gold Standard

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## ABSTRACT

**Background:** Maxillary sinusitis is a common problem with significant physical and social implication in daily life. It is vital to provide a cost effective, reasonably predictive modalities of diagnosis accessible to every individual. X-ray PNS radiography in the form of Water's view could be helpful to diagnose sinusitis. This study aimed to determine the predictive value of X-ray PNS 45<sup>0</sup> (Water's view) in the initial diagnosis of chronic maxillary sinusitis.

**Aim:** To determine the positive predictive value of x-ray para nasal sinuses 45 (water's view) in diagnosis of chronic maxillary sinusitis taking antral wash out as gold standard.

**Methods:** This study was conducted at ENT Department, Sir Ganga Ram Hospital Lahore during 31<sup>st</sup> May 2012 to 31<sup>st</sup> November 2012. A total of 300 cases of sinusitis were included in the study after detailed history taking and clinical examination. All the patients underwent X-ray PNS 45<sup>0</sup> radiography (Water's view) and antral washout. The predictive values for every radiological outcome were done taking Antral Washout as confirmative test.

**Results:** Out of total, 72.1% of X-ray PNS 45<sup>0</sup> evidenced maxillary sinusitis. The radiological findings on sinus radiography were; haziness 116(40.0%), opacity 40(13.8%), air-fluid level 6(2.1%) and mucosal thickening 47(16.2%). The antral wash return was positive in: Air fluid levels 100%, opaque antra: 92.5%, Mucosal thickening: 38.3%. Over all reliability of X-ray PNS 45<sup>0</sup> was 55% in predicting antral wash effluent. However it was 79% sensitive in diagnosing maxillary sinusitis.

**Conclusion:** The presence of air fluid levels and sinus opacification on X-ray PNS 45<sup>0</sup> are more reliable evidences of maxillary sinusitis as compared to haziness and mucosal thickening. X-ray PNS 45<sup>0</sup> of the maxillary sinuses gives main diagnostic obligations regarding maxillary sinus pathology however the final diagnosis should also be based on history and clinical findings.

**Keywords:** Chronic Maxillary Sinusitis, Antral Wash, X-ray PNS.

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## INTRODUCTION

Sinusitis is one of the most regular conditions diagnosed in Ear Nose and Throat department<sup>1</sup>. Maxillary sinus is the most commonly involved sinus, as has been shown in many studies<sup>2,3,4,5,6</sup>.

Rhinitis and sinusitis are frequently associated clinical conditions<sup>7,8</sup>. Terms rhinosinusitis and sinusitis should be used interchangeably<sup>8,9</sup>. Chronic rhinosinusitis(CRS) is defined as a rhinosinusitis of more than 12 weeks without complete resolution<sup>10</sup>, with symptoms of nasal obstruction, facial pain or pressure, nasal discharge, loss of sense of smell<sup>3,5,9</sup> and objective evidence of sinus disease by means of direct visualization or imaging studies<sup>8,11</sup>.

CRS, often significantly affects general quality of life of patients related to bodily pain and social functioning, which may be greater than that caused by other chronic diseases<sup>9,12</sup>. It is a common problem affecting up to two per cent of the world population<sup>13</sup>. CRS exacts a high cost in terms of direct health care

as well as lost productivity.<sup>14,15</sup> Obstruction of the narrow airways of the ostiomeatal complex has been proposed as an important mechanism in the generation of symptoms and the etiology of chronic rhinosinusitis<sup>3,8,16</sup>.

Although the obstruction of the natural ostia of sinuses can occur due to great many reasons, viral upper respiratory tract infections and allergic inflammation are by far the most frequent culprits<sup>6</sup>. The main causes of the CRS are infections or mechanical obstructions caused by anatomical changes<sup>8,17,18</sup>.

The diagnosis of chronic sinusitis requires detailed medical history and objective evidence of sinus disease by means of direct visualization /endoscopy or imaging studies<sup>9,11</sup>.

Plain radiographs have no or limited role in the evaluation of sinusitis in developed countries<sup>3,5,9</sup>. Advanced strategies such as comprehensive nasal endoscopic examination and CT scan of the sinus are costly and inaccessible to the people living in rural areas<sup>5</sup>. One possible available option of diagnostic strategy at primary health care facilities in developing and underdeveloped countries could be

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X-Ray PNS 45° as they are cheap and readily available tool<sup>6</sup>. Even in regions without electrical power supply, radiographs can be taken with the use of rechargeable battery powered mobile units.

The possible findings in radiograph regarding sinusitis include mucosal thickening, air fluid levels, and complete opacification of involved sinuses<sup>2,19,20</sup>. Mucosal thickening is common almost in 90% of patients, it is a nonspecific finding<sup>21,22</sup>. Air fluid levels and opacification are more precise and observed in about 60% of the patients<sup>21</sup>. However the interpretation of X-ray is very important<sup>1</sup> and it depends upon competency of medical practitioner.

In our setup where majority of people are living in rural areas where the only medical facility available is first level care facilities, patients who have sinusitis and can not afford MRI and CT, most commonly done and the only available diagnostic strategy for sinusitis is plain radiograph. Hence the use of PNS 45° X-ray in such patients is strongly indicated. Such circumstances necessitate determining the predictive value of PNS 45° X-ray in our patients with sinusitis and infer if the continued usage is warranted.

## MATERIALS AND METHODS

This study was a prospective cross sectional survey conducted at department of ENT; Sir Ganga Ram Hospital Lahore from 31<sup>st</sup> May 2012 to 31<sup>st</sup> Nov 2012. Sample size of 300 cases was calculated with 95% confidence level, 4% margin of error and taking positive predictive value of x-ray PNS 45° (water view) i.e., 87.5 in patients of chronic maxillary sinusitis taking antral washout as gold standard. This was a non probability purposive sample.

Patients presenting for the first time with symptoms of rhinorrhea, nasal obstruction, headache, facial pain, not recovering by medication and on x-ray PNS 45° having haziness, opacification or air fluid level in maxillary sinuses were included in the study. Patients with tumor, polyp, and allergic mucosal thickening of middle meatus on clinical examination and patients with history of previous nasal surgery were excluded. Patient younger than 3 years or patient older than 55 years and those with history of allergy to lignocaine and ischemic heart disease were also excluded.

Patients fulfilling inclusion and exclusion criteria were seen in ENT outdoor. X-ray PNS was carried out. Patient with findings on x-ray PNS was called next day in ENT Operation Theater for antral washout under local anesthesia after taking informed consent. Their socio-demographic information was recorded. Past histories of disease were noted. Antral wash out was carried out after packing both nostrils with 4% lignocaine, puncturing medial wall of maxillary sinus

in the region of inferior meatus. Sinus was irrigated and the colour and consistency of water coming out after irrigation was analyzed after collecting it in wash basin.

Patients were sent home on same day on oral medication. In case of excessive nasal bleeding, packing was done with bismuth iodide paraffin paste and patient was observed. All data were collected using a pre-tested, structured performa prepared for the purpose and SPSS version 16 was used for analysis. Age was presented as mean. Gender and positive predictive value of x-ray PNS finding in chronic maxillary sinusitis by taking antral washout as gold standard, were presented as percentages and frequency.

## RESULTS

A total of 300 patients were seen over the study period. Ten patients were either having history of allergy to lignocaine or refused to get their antral washout done. These patients therefore were excluded from the study.

Out of 290, 167(58%) were male and 123(43%) female patients with a male-to-female ratio of approx. 1.3:1, with a mean age of 28 years (range, 10–60 years). while the duration of symptoms ranged from few months to 5 years (Fig. 1). Highest age incidence was in the third decade i.e., 20-29 age groups. Least commonly affected were adolescents and elderly (Fig. 2).

Most prominent symptoms were, nasal discharge 247(84.9%), nasal obstruction 73(25.2%), nasal bleeding 63 (21.8%) and sneezing 58(20.6%) patients. Septal deviation was seen in 20(06.9%) patients. Of the *major* factors for diagnosis of sinusitis, most common finding in this study was nasal discharge and nasal obstruction followed by nasal bleeding and septal deviation (Table 1).

The maxillary sinus, 190 cases (65%) was the commonest sinus involved. There were 90(31%) cases of inflammation of all the sinuses (pansinusitis) and more than one sinus but not all (multisinusitis) in 03.5% of the cases. (Table 2)

The radiographic evaluation showed that 81(27.9%) sinuses were clear on X-ray PNS 45°. However rest (72.1%) of the cases was having some sort of finding of clinical significance. These finding were; 116(40.0%) cases of haziness, 40(13.8%) of opacity, 6(2.1%) showed an air-fluid level mainly effecting the right maxillary sinus and 47(16.2%) had mucosal thickening (Table 3).

Of all the sinuses irrigated majority of the returns obtained were Clear (45%). Among the abnormal returning fluids, most common was the purulent returning fluid which was found in 68(32.5%) of

sinuses. Mucoïd and mucopurulent return was seen from 32 (15.3%) and 15 (7.2%) antra respectively (Table 4).

Out of 116 antra for haziness positive, 54 returned positive antral wash, thereby giving 46.55% accurate prediction. Similarly, the opaque antra returned 37 positive washouts indicating 92.5% prediction. Air-fluid level has shown 100% prediction; while 47 antra with mucosal thickening resulted in 18 positive returns of antral wash giving 38.3% prediction (Table 5)

From this study we observed that the overall reliability of Plain X-ray in predicting antral lavage effluent is about 55%.

Fig 1: Distribution of participants by gender

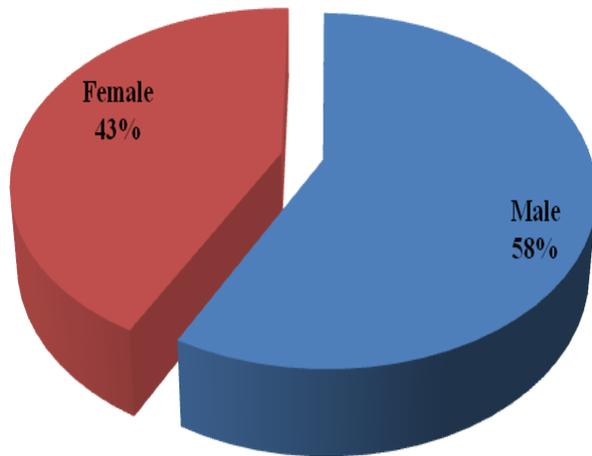


Fig.2: Distribution of cases according to age

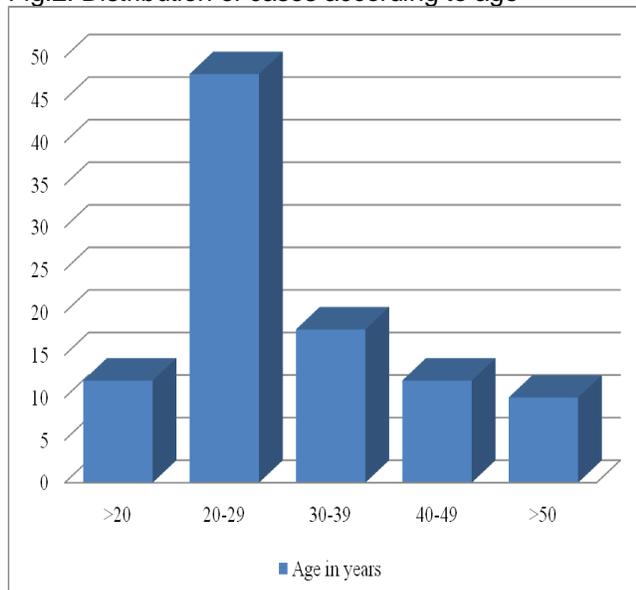


Table 1: Clinical features of the patients gone through history & physical examination (n=290)

Sites	Finding	Frequency	%age
Nose	Discharge	247	85.0
	Obstruction	73	25.2
	Bleeding	63	21.8
	Sneezing	58	20.6
	Septal Deviation	20	06.9
Throat	Post nasal drip	105	36.0
	Hyperemic oropharynx	46	15.8
Ear	Discharge	20	07.0
	Hearing loss	06	02.0
Others	Eustachean tube dysfunction/Oroantral fistula etc.	29	10.0

Table 2: Involvement of sinuses (n=290)

	n	%age
Maxillary Sinusitis	190	65
Pansinusitis	90	31
Multi-sinusitis	10	03.5
Total	290	100

Table 3: X-ray PNS findings of maxillary sinuses (n=290)

X-ray Finding	Right	Left	Total	%age
Clear	33	48	81	27.9
Haziness	58	58	116	40
Opacity	22	18	40	13.8
Air-fluid level	6	0	6	2.1
Mucosal thickening	25	22	47	16.2
Total	144	146	290	100

Table 4: Findings of antral washout (n=209)

Returning fluid	Right	Left	Total	%age
Clear	51	43	94	45
Mucoïd	21	11	32	15.3
Mucopurulent	7	8	15	7.2
Purulent	32	36	68	32.5
Total	111	98	209	100

Table 5: Reliability of x-ray 45° for a positive antral washout (n=209)

X-ray findings	No. of Antra	+ve lavage No. of Antra	%age
Haziness	116	54	46.55
Opacity	40	37	92.5
Air-fluid level	06	06	100
Mucosal thickening	47	18	38.3
Total	209	115	55

**DISCUSSION**

Out of total 290 patients, 81(27.9%) did not show positive finding in X-ray PNS 45° whereas 209 (72.1%) cases had some sort of radiological finding of clinical significance. In most of subjects maxillary sinuses were involved (65%). Skoulas IG<sup>23</sup>, Sogebi OA<sup>28</sup> and Da Lilly- Tariah OB<sup>6</sup> have also found that it

was the most commonly affected sinus. After initial clinical examination, antral washout was performed in all of these 209 subjects, for the confirmation of the maxillary sinusitis diagnosed on X-ray PNS. Antral lavage is a commonly performed procedure in chronic maxillary sinusitis for both diagnostic and therapeutic purpose<sup>9,25,29</sup>.

However it cannot be done at the level of primary healthcare because it's invasive in nature. Water's view of the paranasal sinuses on other hand has been suggested as the best single view for diagnosing sinusitis<sup>20,26</sup>.

The radiographic finding of X-ray PNS 45° showed 116(40%) cases of haziness, 40(13.8%) opacity and 47(16.2%) mucosal thickening. Willett LR et al<sup>21</sup> found mucosal thickening (90%) as the most common radiographic finding followed by opacity and haziness in his study. While in study by Karla L<sup>24</sup> although most of antra were clear but still MONG cases were majority having mucosal thickening.

Most frequent finding was haziness followed opacity in a study conducted by Sen MK, Samaddar RR<sup>25</sup> and also in another study by Kurien et al<sup>26</sup>, this finding is only slightly different from our present study as we had mucosal thickening (16.2%) as the second common finding after haziness (40%). In our study most common return of the antral wash was clear (45%) followed by purulent (32.5%), this finding was similar to Sen MK et al's<sup>25</sup> study who had clear return in most (48%) followed by mucoid (21%) and purulent (20.6%) while Kurien et al's<sup>26</sup> study showed that the commonest return of antral wash was Purulent(40.8%) in nature.

In our study the returned positive lavage for different radiological findings was; 54/116 in haziness, 37/40 in Opacity, 06/06 in Air-fluid level, 18/47 Mucosal thickening. The positive predictive value of X-ray PNS 45° for; haziness was 46.55%, opaque antrum 92.5% and Air-fluid level showed 100% prediction, while mucosal thickening gave 38.3% prediction.

In our present study, all the sinuses with air-fluid levels yielded a positive antral lavage followed by those that showed radiologic evidence of sinus opacification. Ezeanolue et al<sup>4</sup> reported the same finding. Opaque antrum on X-rays have shown a high probability for positive lavage, as was found in the studies of Kurien et al<sup>26</sup> (100%), Ezeanolue et al<sup>4</sup> (96%) and M K Sen et al<sup>25</sup> (80%). Sogebi OA et al<sup>28</sup> in their study found that fluid level and antral opacity on plain sinus radiography had positive predictive values of 87.5% and 96% respectively on antral lavage. Kay et al<sup>27</sup> in a similar study concluded that the presence of mucosal thickening or haziness was a poor indicator of retained secretions. A similar picture for prediction for positive lavage in case of haziness was

also shown in studies of Sen MK et al<sup>25</sup> (49%), Kurien et al<sup>26</sup> (40%), Ezeanolue et al<sup>4</sup> (29.4%) and Sogebi OA et al<sup>28</sup> (29.4%).

The findings of our study are in agreement with most of the authors<sup>4,25, 26,28</sup> who agree that haziness and mucosal thickening are less reliable whereas air fluid levels and sinus opacification are useful features on radiographs and it is generally accepted that they will make a positive prediction in 80-100% of cases.

From this study we observe that the overall reliability of Plain X-ray PNS 45° in predicting antral lavage effluent is about 55%, also comparable with other studies<sup>4,25,26</sup>. X-ray PNS 45° tested for diagnosis of chronic maxillary sinusitis showed 94 false positive and 30 false negative, ensuing an accuracy of 55%. However the sensitivity of the X-ray PNS came to be 79%.

Ahmed B et al<sup>19</sup> in their study on the role of sinus radiography (water's view) found a sensitivity of 77% and specificity of 37% in chronic maxillary sinusitis when compared with the findings of antral lavage.

Our study has certain important clinical implications. A common approach towards the patients suspected of having chronic maxillary sinusitis is to advise X ray PNS 45°, accompanying with the patient's history and clinical findings.

## CONCLUSION

Sinusitis is a common rhinological disorder encountered in ENT Department; Sir Ganga Ram Hospital Lahore. X-ray PNS 45° (Water's view) is reliable in predicting pathologic antral lavage effluent in 55% patients with high sensitivity of 79%. From the above study it is clear that the radiological finding of air-fluid level in the maxillary sinus is the most reliable evidence of sinus infection followed by opacity, whereas hazy antra and mucosal thickening on X-ray are poor indicators of sinus infection. Hence we conclude that Water's view undoubtedly yields valuable information regarding sinus pathology. Although advanced diagnostic modalities have high predictive values but they are impractical and high-priced in underdeveloped and rural areas of Pakistan.

Thus X-ray PNS 45° is a worthwhile investigation for the diagnosis and treatment of sinusitis but it should not be accepted as a diagnosis in itself but must be considered in the light of the patient's history and clinical findings.

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