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Intranasal-Packing of Non-Steroidal Nasal Decongestants: Its Effect on Computed Tomography of Patients with Nasal Polyposis and Chronic Sinusitis

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Abstract— This study determined whether the secretions in the paranasal sinuses after intranasal packaging application of non-steroidal nasal decongestion has any effect on the paranasal sinus computed tomography (CT) images in patients with nasal polyposis and sinusitis which may result in misdiagnosis or overdiagnosis in radiological evaluation of sinusitis. Respondents of this study were ninety-one (91) adult patients who were diagnosed with sinusitis and polyposis and underwent a paranasal (PNS) sinus CT scan. Every patient was scanned twice pre and post-giving of non-steroidal nasal decongestion thirty (30) minutes prior to PNS CT scanning. Three (3) radiologists reviewed the images. Wilcoxon test was used as the test of significance for the images acquired. Results of the study showed a highly significant difference in the scores for the diagnostic image quality and anatomical structure assessments between pre and post-nasal decongestion showing a p-value of infinity.
Keywords— Paranasal Sinuses, Non-Steroidal Nasal Decongestion, Paranasal Sinus Computed Tomography, Nasal Polyposis, Sinusitis

I. INTRODUCTION

A. Background of the Study

The spectrum of paranasal sinus disease is one of the most common causes of a patient's visit to the otolaryngologist. Symptoms are multiple and vague while the examination is often limited as sinuses cannot be examined directly. CT scanning of PNS (paranasal sinus) provides an excellent definition of the sinuses, thus this became more sensitive than plain radiography in the detection of sinus pathology, especially in the sphenoid and ethmoid sinuses. In the diagnosis of PNS disease, a CT scan should not be routinely used because some findings may be non-specific. CT scan's primary role is to help in the management and diagnosis of recurrent as well as chronic PNS diseases (Agarwal, Fefar, & Mehta, 2018).

The application of a topical non-steroidal-containing vasoconstrictive agent such as oxymetazoline gives the best visualization of the nasal mucosa. Significant opacifications and mucosal thickening with the presence of an air-fluid level are all signs of disease. Also, following closely is the giving of nasal

corticosteroids which have been shown to decrease the inflammatory process of the nasal mucosa. It has been studied as adjunctive therapy and found a significant reduction in several symptom scores and shows no increase in adverse events (Leung & Katial, 2008). However since the acute withdrawal of nasal corticosteroids has been attributed to a dreaded complication such as *rhinitis medicamentosa*, the authors decided to use a non-steroidal containing nasal decongestants instead.

The purpose of radiological imaging in inflammatory lesions in the paranasal sinuses as well as in the nasal cavity is to confirm the diagnosis with a better and more precise, characterization of the extent and localization of the disease and anatomical variants in order to select patients that may benefit from sinus surgery. CT (Computed Tomography) offers and provides an excellent bony anatomical delineation and extent of the sinus disease and serves as a "road map" in surgical procedures. Therefore, Computed Tomography (CT) is regarded as the "Gold Standard" in paranasal sinus imaging (Bachert, Hormann, Mosges, Rasp, Riechelman, Muller, Luckhaupt, Stuck, & Rudack, 2003).

There are no established guidelines regarding the pre-procedural administration of nasal decongestants during a CT scan of the PNS (paranasal sinus). However, the medical institution on which this study has been based has a long practice in the administration of non-steroidal-containing nasal decongestants to hypothetically reduce nasal symptoms with the hope of eliminating inflammatory causes that may obscure masses and other occult lesions. This procedure gained variable opinions among radiologists in the institution as to its effectiveness in arriving at quality imaging of the PNS. This study then has been proposed to enable radiologists to validate whether this practice is practical and useful by improving the image quality of the paranasal sinus CT scan images for better treatment and for surgical management and planning. This study will also help in streamlining paranasal CT studies protocol in medical institutions.

Overall, this study provided a greater definition of the sinuses in detecting sinus pathology including the emphasis on the advantage of pictorial display CT images for better visualization allowing rational surgical planning and management.

Objectives of the Study

The study would like to know if pre-procedural administration of the non-steroidal-containing nasal decongestants provides better image quality for patients undergoing paranasal CT examination using the standardized CT image Quality Assessment Tool.

Specifically, the study aims to determine the following:

1. Demographic (sex and age) and clinical profile (history of smoking, allergies) of the patients.

2. To determine whether the administration of nasal decongestants will provide better tissue (soft and bone) delineation in CT scans that will result in an accurate diagnosis of the paranasal disease using the CT Quality Assessment Tool.

B. Conceptual Framework

The conceptual framework of the study showed whether the administration of non-steroidal nasal decongestants provides better image quality for patients undergoing paranasal CT examinations.

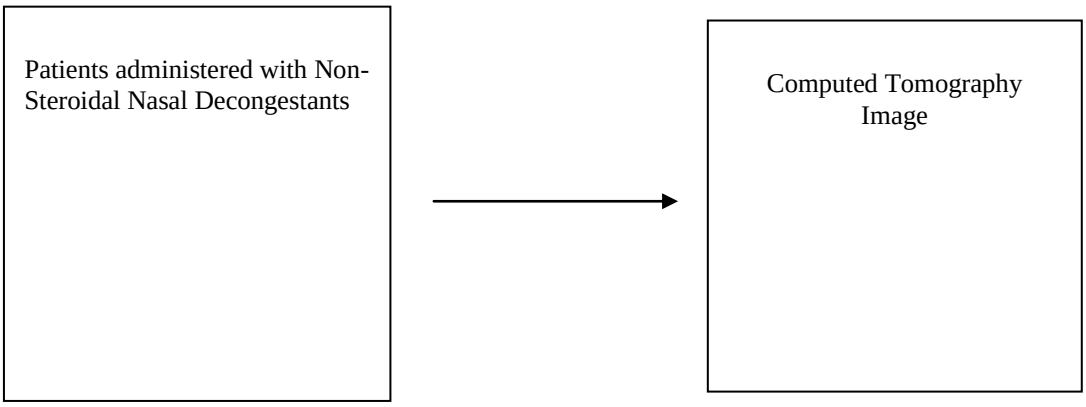

Figure 1. Conceptual framework of the study.

C. Methodology

Research Design and Sampling

This study utilized a prospective cross-sectional study design. Ninety-one (91) adult patients who were diagnosed with sinusitis and polyposis, and underwent a paranasal (PNS) sinus CT scan were the respondents of this study. The study was conducted in the Department of Radiological and Imaging Sciences, CT scan section at the Southern Philippines Medical Center, Davao City. All patients were referred to the Department of Radiological and Imaging Sciences facility at Southern Philippines Medical Center for paranasal sinus CT scan examination. Below are the inclusion and exclusion criteria.

Inclusion Criteria:

All consenting patients of legal age (18 years old and above) are referred to the radiology department for paranasal sinus with contrast CT scan diagnosed with acute and chronic sinusitis with or without nasal polyposis.

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Exclusion criteria:

Patients with co-morbidities such as:

A. Nasal malignancies.

B. Trauma

C. Hypertensive and diabetic patients

D. Patients who were recently treated with nasal decongestants with or without steroids (within 3 days to 1 week) from the conduct of the PNS CT scan study.

E. Patients who have a history of allergy to food and drugs.

F. Patients with abnormal eGFR and serum creatinine.

G. Patients with acute renal infection and chronic renal failure.

H. Patients with mental incapacity or mentally challenged.

I. Patients with contraindicated conditions as to the administration of non-steroidal nasal decongestants such as hyperthyroidism, heart failure, prostatic hyperplasia, and pregnancy.

Data Collection and Procedures

Every patient was scanned twice pre and post-giving of non-steroidal nasal decongestion thirty (30) minutes prior to PNS CT scanning. Three (3) radiologists reviewed the images. Wilcoxon test was used as the test of significance for the images acquired.

Consents for the diagnostics and therapeutic radiologist's procedures were obtained. Careful history taking was instituted such as current medications used, allergy status, and previous surgical procedures. All patients were asked to complete a pre-procedural questionnaire (Sino-Nasal Outcome Test) inquiring about subjective symptoms including nasal obstruction, rhinorrhea, postnasal discharges (PND), headache, facial pain/ pressure, and/or olfactory disturbances, and some related symptoms such as cough and asthma. The patients who qualified to participate in the study were then subjected to a plain CT scan examination after which an intranasal decongestant was given to them. The nasal decongestants were shouldered by the principal reviewer and given for free to those selected patients enrolled in the study. The nasal decongestant with oxymetazoline is a vasoconstrictor that narrows blood vessels. The patients who qualified to receive were asked to blow their noses prior to the administration of the medication to make it more effective. A cotton ball or a small wad of gauze was soaked with the nasal decongestant and rolled into a shape to fit into each nostril. The cotton/ gauze was kept sterile and saturated all the time. The nostrils then were pinched slowly for 10 minutes leaving the cotton/ gauze preventing it from leakage and dripping the decongestants. Then a contrast-enhanced computed tomography (CT) of the paranasal was performed if needed and was studied in detail.

Scan protocol included are the following:

1. Nominal slice thickness at 3mm in axial scan and direct coronal scan.
2. Scans were in three planes- axial, coronal, and sagittal.
3. Both soft tissues and bone windows were obtained.

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4. Interpretation and Imaging Assessment using a preformed tool of the study were done by at least three (3) senior CT scan readers who were senior radiologist consultants reading PNS CT scans for the past 10 years.

Data Analysis

Categorical data were analyzed using descriptive statistics. CT Image Quality Assessment Analysis was pursued using Wilcoxon's signed Rank Test. Inter-observer variability was likewise analyzed using the coefficient of Variance.

Image Quality Assessment

The assessment of the image quality was based on the following criteria: First, the diagnostic image was assessed by the complete opacification of one or more of the sinuses, air-fluid level, presence of mucosal thickening, and any bony abnormalities (thickening or lysis and sclerosis), nasal septum deviation, and turbinate hypertrophy. Scores were ascribed as follows: 0- If the finding is not seen radiologically.1- If the finding is visible however indeterminate or ill-defined and 2- If the finding is clearly seen radiologically.

Secondly, there were clinically important and relevant anatomical structures of the paranasal sinuses and nasal cavities which were also considered the following: maxillary ostium, uncinate process, the frontal and maxillary sinuses, osteomeatal complexes (including the ethmoidal infundibulum, Ostia of anterior and middle ethmoidal air cells and middle meatus), frontal recesses, anterior ethmoidal air cells (including the agger nasi cells- frontal anterior ethmoidal air cells), Posterior ethmoidal air cells, sphenoid sinus, and its septum, lamina papyrecea, and the path of both optic nerves, basal lamina that divides the anterior and posterior air cells, spheno ethmoidal recess (including the ostium of the sphenoid sinus).

The reviewers were at least 3 senior radiologist CT scan consultants reading PNS for the last 10 years. Before institutionalizing the reading, a workshop was made for CT consultant staff for uniformity of language/ description used to avoid inter-observer bias. The reviewers were asked to compare whether the appearance of the anatomical structures is normal, indeterminate, or abnormal. Scores were graded as follows, 0- If the structure is radiologically normal, 1- If the anatomic structure is indeterminate or ill-defined, and 2- If the anatomic structure is not visible.

The mucosa was considered to be normal if it was not visible and was considered abnormal (thickened) if it was visible. Indeterminate findings include those instances in which a reviewer is doubtful or in which the anatomic structure will not be seen. The bones will be considered abnormal if there is sclerosis, thickening, or lysis noted. The spheno ethmoidal and frontal recesses will be considered abnormal if these recesses are not seen to be patent.

For every scan, the diagnostic image quality scores will be added together to achieve an overall quality rating. The minimum possible score for the assessment of the diagnostic image quality will be 0 while the maximum score will be 12. Similarly, for each study, the scores of the paranasal sinuses and cavities assessment will be added together to achieve an overall quality rating and the minimum possible score for this will be 0 and the maximum score will be 24.

D. Results and Discussion

Basic Demographic Data and Characteristics of the Studied Patients (Table 1)

There were 91 patients included in the study. The majority were males (56 or 62%). The mean age of the patients included was 39.8 years (SD =+/- 15.6). More than half (51%) were professed smokers, and only a fraction (3 or 3%) had a history of allergy.

Table 1. Socio-demographic and Clinical Profile of the Research Subjects (N=91)

DEMOGRAPHICS		
GENDER	**n**	**%**
Male	56	62%
Female	35	38%
Age, Mean +/- SD **39.8 +/- 15.6**		
18 to 25	20	22%
26 to 35	14	15%
35 to 45	17	19%
>45	40	44%
SMOKING PRACTICES		
Yes	46	51%
No	45	49%
HISTORY OF ALLERGY		
Allergy to Chicken	3	3%
No Allergy	88	97%

CT ASSESSMENT TOOL ACCORDING TO PATHOLOGY

Based on the analysis of the overall total score of both protocols by all the reviewers shows no significant difference in the total scores of all the CT images reviewed.

Table 2. Mean scores and significance of overall diagnostic image quality assessment according to Pathology

REVIEWERS	MEAN SCORES		P-VALUE
	PRE ND	POST ND	
Radiologist 1	9.31	10.29	0.00
Radiologist 2	9.29	10.29	0.00
Radiologist 3	9.12	10.41	0.00

WILCOXON SIGNED-RANK TEST
P-VALUE- < 0.05 MEANS SIGNIFICANT DIFFERENCE.

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ASSESSMENT OF ANATOMICAL STRUCTURES

Analysis of the overall total score of both protocols by the first, second and third reviewers (Radiologists 1,2 3), showed no differences in the total scores of all the CT images reviewed.

Table 3. Mean scores and significance of overall assessment of the selected anatomical structures.

REVIEWERS	MEAN SCORES		P-VALUE
	PRE ND	POST ND	
Radiologist 1	20.93	21.39	0.01
Radiologist 2	20.26	21.69	0.00
Radiologist 3	20.22	21.87	0.00

WILCOXON SIGNED-RANK TEST
P-VALUE- < 0.05 MEANS SIGNIFICANT DIFFERENCE

INTER-OBSERVER VARIABILITY

The coefficient of variance (CoV) calculated for the assessment of the pathologic structures between the first and second reviewers for both protocols were 6.20% and 7.00%, respectively. The calculated CoV between the first and third reviewers were 8.00% and 10.40%, respectively. Between the second and third reviewers were 7.00% and 9.40% for both protocols, respectively (See Table 4).

The CoV that was calculated for the assessment of the anatomical structures for both protocols in the first and third reviewers was 15.20% and 11.60%. The calculated CoV that was calculated for the assessment between the first and third reviewers was 16.10% and 14.00% while the second and third reviewers for both protocols were 10.40% and 13.40%, respectively (See Table 4).

The variability in the individual scores was noted in the radiological findings like turbinate hypertrophy, air-fluid level, and some degree of nasal deviation. These discrepancies were not due to the effect of the different protocols used in the scanning.

TABLE 4. INTER-OBSERVER VARIABILITY

REVIEWERS	PATHOLOGY		ANATOMICAL STRUCTURES	
	PRE ND	POST ND	PRE ND	POST ND
Radio 1 and Radio 2	6.20	7.00	11.60	15.20
Radio 2 and Radio 3	7.00	9.40	13.40	10.40
Radio 3 and Radio 1	8.00	10.40	14.00	16.10

Discussion

A total of 91 patients were included in the study majority were males. Most of the patients were adults with a mean age of 39.8 years (SD=+/- 15.6). A little more than half were smokers and only a few had a history of allergies.

There were highly significant improvements in the PNS CT Scan Images in terms of clearing opacified sinuses comparing the pre-nasal decongestion and the post-nasal application of decongestion PNS CT Scan images. Such findings were supported by the consistent CT IMAGING Assessment Tool among three independent radiologists.

The mainstay of treatment of chronic rhinosinusitis is through the administration of topical nasal drugs. The delivery and intranasal distribution of these is therefore of potential significance.

The study shows that there is a significant difference in giving nasal decongestion as shown in Table 2. Although there was a small difference in individual scores in fluid-fluid level and turbinate hypertrophy, these structural assessments may be subjective.

As for the assessment of the clarity of the anatomical structures, again, there was a significant difference between the pre-procedural and post-procedural nasal decongestion. Individually, there were small discrepancies in the total and individual scores between the reviewers. The small discrepancies may be due to anatomical variation in different patients in which some of these structures like turbinate hypertrophy were not identified in some of the scans.

II. CONCLUSIONS

The overall findings are agreeable and suggest that topical nasal vasoconstriction will be applied with a CT paranasal scan. This can decrease mucosal volume and may reduce the turbinate size and appear to reduce mucosal thickening. The administration of non-steroidal nasal decongestants through nasal packing 30 minutes prior to PNS CT scanning among these patients was a valuable method to clear sinuses leading to better visualization of paranasal pathology for better medical and surgical planning.

It is recommended that a hospital policy be adopted in the administration of non-steroidal nasal decongestants through nasal packing thirty (30) minutes prior to a PNS CT scan on all patients who are clinically diagnosed with nasal polyposis and chronic sinusitis for better evaluation of the paranasal sinuses. A similar study can be done among patients seeking a PNS CT scan on all other pathology such as beginning malignant processes and other benign soft tissue and vascular tumors.

A similar study on PNS CT Scan CT Imaging quality may be done using the LUND-MACKAY CT Imaging score for paranasal sinuses to reinforce detailed findings.

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