

## Brief report

### Diagnostic value of ultrasonography in children with maxillary sinusitis

Nafisimoghadam Reza<sup>1</sup>, Tajiki Ali<sup>2</sup>, Vaziribozorg sedighe<sup>3</sup>, Borjjan Laleh<sup>4</sup>

1 -Associate Prof ,Department of Radiology, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

2 -Resident , Department of Radiology, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

3 -Researcher, Otorhinolaryngology research center, Department of Otolaryngology Head & Neck Surgery, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

4 -Resident , Department of Emergency Medicine , Shahid Sadoughi University of Medical Sciences, Yazd, Iran.

Corresponding author: Laleh Borjjan

Email: [aleh.borjjan1090@gmail.com](mailto:aleh.borjjan1090@gmail.com)

#### Abstract

**Objective:** Sinusitis is known as the most common pediatric disease with non-specific signs and symptoms. The standard method for specific diagnosis is to obtain a culture of sinus contents which is not often used because of the invasive nature of the technique. Ultrasound laboratory procedures have made a lot of progress in recent years with increased accuracy. Considering lack of ionizing radiation, ease of use, repeatable nature, affordability, being portable in clinical usage, and appropriate performance especially in children compared to adults (regarding undeveloped thin bones of the sinuses), ultrasonography can be used as a diagnostic procedure to detect maxillary sinusitis in children. Therefore, finding a simple, rapid, accessible, and safe paraclinical method is required for diagnosis of the disease while preventing unnecessary antibiotic therapies.

**Methods:** In this cross-sectional study, 69 children aged under 15 with maxillary sinusitis were randomly selected. Their disease had been diagnosed by pediatricians and confirmed by physical examinations and simple radiographs (Water's view). The children then underwent maxillary sinus ultrasonography. All ultrasounds of the 69 children were performed by one individual (resident of radiology) using a Siemens Acuson X300 ultrasound system and 4-9 MHz transducer.

**Results:** The mean age of the patients was 9.02 years with a standard deviation of 2.7. 44.9% of the subjects were male and 55.1% female. The most common radiographic findings were related to sinus opacity (71%) and increased sinus mucosa had the highest frequency in ultrasonography (98.6%). There was no significant correlation between the radiological findings and the mean age. According to agreement coefficient (Kappa = 0.03%), there was no agreement in diagnosis of an increase in mucosal thickness between the results of ultrasound and radiography, however, the results showed a good agreement in detection of fluid accumulation in the sinuses (Kappa = 0.8).

**Conclusion:** The results of our study revealed that although the results of ultrasound and radiography showed no agreement in diagnosis of sinus mucosal thickening, there was good agreement in detection of fluid accumulation and air-fluid level in the sinuses.

**Keywords:** Sinusitis, Ultrasound, Children..

#### Introduction

Sinusitis is considered as one of the most common childhood diseases with non-specific signs and symptoms. The standard method for specific diagnosis of this disease is through a culture of sinus contents that is often not used because of the invasive nature of the technique. Ultrasound

laboratory procedures have made a lot of progress in recent years with increased accuracy. Considering lack of ionizing radiation, ease of use, repeatable nature, affordability, being portable in clinical usage, and appropriate performance especially in children compared to adults

(regarding undeveloped thin bones of the sinuses), ultrasound can be used as a diagnostic procedure in detection of maxillary sinusitis in children [1]. Therefore, finding a simple, rapid, accessible, and safe paraclinical method is required for diagnosis of the disease while preventing unnecessary antibiotic therapies.

### Methods

This cross-sectional study was conducted on 69 children aged under 15 from March 2014 to December 2014. The subjects had been diagnosed with maxillary sinusitis by pediatricians confirmed by physical examinations and maxillary sinusitis radiographs. Informed consent was obtained from the legal guardians of the children for being included in the study. The study was approved by the University Ethics Committee and performed in Shahid Sadoughi Hospital, Yazd.

All sinus ultrasounds of the 69 children were performed by one individual (resident of radiology) using a Siemens Acuson X300 ultrasound system and 4-9 MHz transducer. The patients were placed in sitting position with the head slightly bent forward and the converter was transversely placed in infra-orbital and external nasal region (bilateral anterior maxillary sinus). Maxillary sinus was considered normal if there were echoes of sound waves caused by the presence of air in the sinuses. Diagnosis of maxillary sinusitis (inflammation of the maxillary sinus) in children was confirmed in case of any of the following sonographic findings:

1. Thickening of sinus mucosa as increased soft tissue (observing a hypoechoic image without a shape of triangle with no limits specified in the maxillary sinus)
2. The presence of fluid in the sinuses (sinusitis complications including abscess and wall invasion)

### Result

This study was conducted on 69 children under 15 years of age from March 2014 to December 2014. The subjects had been diagnosed with maxillary sinusitis by pediatricians confirmed by physical examinations and simple radiographs (Water's view). The mean age of the patients was 9.02 years with a standard deviation of 2.7, 44.9% being male and 55.1% female. The most common radiographic findings were related to sinus opacity (71%) and increased sinus mucosa showed the highest frequency in ultrasonography (98.6%) (Table 1). No significant correlation was found between the radiological findings and the mean age (Table 3). According to Table 2 and agreement coefficient (Kappa = 0.03%), the results of ultrasound and radiography were not in agreement about the diagnosis of an increase in mucus thickness.

However, as shown in Table 3, the results of ultrasound and radiography showed good agreement in detection of fluid accumulation in the sinuses (Kappa = 0.8).

Table 1. The frequency of radiographic findings and ultrasound in children with sinusitis

X-ray	Sinus opacification	71%
	Invasion of the sinus wall	3.4%
	Air-fluid level	9.44%
Ultrasonography	Sinus mucosal thickening	6.98%
	The fluid in the sinuses	6.40%

Table 2. The frequency of sinus mucosal thickening on the ultrasonography in terms of the Radiography results in children with sinusitis

		Ultrasonography		Total
		Increased thickness	Not increased thickness	
X-ray	Thickening of the sinus mucosa	48 98%	1 2	49
	Not thickening of the sinus mucosa	20 100%	0 0%	20
<b>total</b>		68 6.98%	1 ¼%	69

Table 3. Determination and distribution of fluid in the sinuses in radiographic results in terms of ultrasound findings in children with sinusitis

		Ultrasonography		Total
		Accumulation of fluid in the sinuses	No Accumulation of fluid in the sinuses	
X-ray	Accumulation of fluid in the sinuses	26 9.83%	51.16 %	31
	No Accumulation of fluid in the sinuses	2 3.5 %	36 7.94 %	38
<b>Total</b>		28 6.40 %	41 4.59 %	69

## Discussion

Maxillary sinusitis is defined as an inflammatory process or infection with accumulation of fluid in the sinuses. The children sometimes have non-specific complaints such as rhinorrhea, cough, fever, nasal voice, headache, inflammation of the nasal mucosa, sinus tenderness, and PND [7]. Sinus infection is diagnosed through puncture and bacterial culture, but due to the invasive nature of the procedure, non-invasive or minimally invasive imaging methods including x-ray, CT, MRI and ultrasound are used to confirm this detection. However, they may cause a false positive diagnosis.

In case of thickness of mucosal polyps, sinus cysts, or anatomical anomalies, CT scan is the gold standard in the diagnosis of sinusitis. However, it is believed that this method should only be applied in special cases such as recurrent and chronic sinusitis, and cases not responding to treatment. Some researchers have confirmed the use of imaging in non-complicated rhinosinusitis in children below 6 years of age (7.6), while another study did not find it necessary in acute non-complicated rhinosinusitis [8].

Ultrasonography was first used by Mann in 1975 for diagnosis of sinusitis [9]. Few studies have investigated the role of ultrasound in diagnosis of rhinosinusitis in adults and children.

In a study in 2012, Otilia et al. compared ultrasound with the maxillary sinus x-ray. The sensitivity of ultrasound for accumulation of fluid in the sinuses and mucosal thickness was 94.8% with a specificity of 98%. They showed that ultrasonography was not appropriate for assessment of mucosal thickness, but could be used as an alternative method for assessing

In a study by Mori et al. in 2014, Japan, 18 patients with maxillary sinusitis with a mean age of 10 years were examined by ultrasound and radiographic imaging where the sensitivity and specificity of ultrasonography were 92% and 100%, respectively. According to the results of their study, sensitivity of sonography in the diagnosis of maxillary sinusitis was higher than a simple graph while it was almost similar to the sensitivity of CT in assessing the severity of maxillary sinusitis [3].

Investigating 85 children in 2009, Revonta et al. concluded that both sonography and radiology had the same value in primary diagnosis of maxillary sinusitis. They found sonography as a relatively inexpensive and low-risk method which can be easily repeated [14]. The results of the present study showed that despite no consensus between the results of sonography and radiography in diagnosis of sinus mucosal thickening, a good

agreement was achieved in detection of the fluid in the sinus and air-fluid level.

## References

- .1 Kronemer, K.A. and W. McAlister, Sinusitis and its imaging in the pediatric population. *Pediatric radiology*, 1997. 27(11): p. 837-846.
- .2 Fufezan, O., et al., The role of ultrasonography in the evaluation of maxillary sinusitis in pediatrics. *Medical ultrasonography*, 2010. 12(1): p. 26-33.
- .3 Mori, A., et al., [Comparison of B-mode ultrasonography and computed tomography in the evaluation of maxillary sinusitis in pediatric patients]. *Nihon Jibiinkoka Gakkai kaiho*, 2014. 117(1): p. 26-33.
- .4 Zagolski, O. and P. Strek, [Ultrasonography of the nose and paranasal sinuses]. *Polski merkuriusz lekarski: organ Polskiego Towarzystwa Lekarskiego*, 2007. 22(127): p. 32-35.
- .5 Puhakka, T., et al., Validity of ultrasonography in diagnosis of acute maxillary sinusitis. *Archives of Otolaryngology-Head & Neck Surgery*, 2000. 126(12): p. 1482-1486.
- .6 Varonen, H., et al., Comparison of ultrasound, radiography, and clinical examination in the diagnosis of acute maxillary sinusitis: a systematic review. *Journal of clinical epidemiology*, 2000. 53(9): p. 940-948.
- .7 Wald, E.R., et al., Acute maxillary sinusitis in children. *New England Journal of Medicine*, 1981. 304(13): p. 749-754.
- .8 Laine, K., et al., Diagnosing acute maxillary sinusitis in primary care: a comparison of ultrasound, clinical examination and radiography. *Rhinology*, 1998. 36(1): p. 2-6.
- .9 Mann, W., C. Beck, and T. Apostolidis, Liability of ultrasound in maxillary sinus disease. *Archives of oto-rhino-laryngology*, 1977. 215(1): p. 67-74.
- .10 Rohr, A., et al. Comparison of x-ray and ultrasound in the diagnosis of maxillary sinusitis. in *ANNALS OF ALLERGY*. 1984. AMER COLL ALLERGY ASTHMA IMMUNOLOGY 85 WEST ALGONQUIN RD SUITE 550, ARLINGTON HTS, IL 60005.
- .11 Reilly, J.S., et al., Use of ultrasound in detection of sinus disease in children. *International journal of pediatric otorhinolaryngology*, 1989. 17(3): p. 225-230.
- .12 Jousimaa, J., Sinus ultrasound and radiography in the diagnosis of sinusitis.
- .13 Belić, B., et al., Mode ultrasonography and roentgenography in diagnosing chronic

nonpolypoid maxillary rhinosinusitis. *Acta chirurgica iugoslavica*, 2009. 56(3): p. 139-144.

.14 Revonta, M. and I. Kuuliala, The diagnosis and follow-up of pediatric sinusitis: Water's view radiography versus ultrasonography. *The Laryngoscope*, 1989. 99(3): p. 321-324.