

Comparison Between A-Mode Ultrasonography And Radiography In The Diagnosis Of Maxillary Sinus Diseases¹

Dr. Mehmet KOYUNCU², Dr.Şinası YALÇIN³, Dr. Erol İNAN³,
Dr. Onur ÇELİK³

1 The study was done at Frat University, Medical School Otolaryngology Dept.

Elazığ

2 Otolaryngology Dept., Ondokuz Mayıs Uni. Medical School Samsun

3 Otolaryngology Dept., Frat Uni., Medical School Elazığ

✓ A-mode ultrasound examination of the maxillary sinus was compared with radiological examination in 387 subjects suggestive of paranasal sinus diseases to detect sensitivity, specificity and confidence of the ultrasonography in the diagnosis of the maxillary sinus diseases. Ultrasound tracings were obtained with Atmos model ultrasound and the records were interpreted by the same two authors. Waters' view radiography was performed on all patients. The patients were classified according to their age. In the adult group; ultrasonography had an overall sensitivity of 68%, specificity of 93% and confidence of 85% in the detection of secretion; sensitivity of 95%, specificity of 92% and confidence of 93% in the detection of mucosal thickening; sensitivity of 66%, specificity of 86% and confidence of 84% in the detection of cystic lesion of the maxillary sinus. In the children group; ultrasonography had an overall sensitivity of 92%, specificity of 3% and confidence of 93% in the detection of secretion; sensitivity of 95%, specificity of 94% and confidence of 95% in the detection of mucosal thickening, sensitivity of 50%, specificity of 97%, confidence of 95% in the detection of cystic lesion of the maxillary sinus. When compared with surgical findings, Water's view radiography and ultrasonography of the maxillary sinus, A-mode ultrasonography with a sensitivity of 94% seemed to be a reliable diagnostic method in the diagnosis of maxillary sinus diseases and it also gave useful information in the follow up course of the therapy of paranasal sinus diseases.

Ky Words: A-mode ultrasonography, Radiography, Maxillary sinus disease..

✓ **Maksiller Sinüs Hastalıklarının Tanısında A-Mod Ultrason ve Radiografisinin Karşılaştırılması**

Paranasal sinus hastalığı şüphesi olan 387 kişide, maksiller sinüs hastalığının tanısında ultrasonografinin duyarlılık, özgünlük ve güvenilirliğini tespit etmek amacıyla maksiller sinüsün A-mod ultrason muayenesi radyolojik muayene ile karşılaştırıldı. Ultrason traseleri Atmos model ultrason ile elde edildi ve kayıtlar aynı iki otor tarafından yorumlandı. Bütün hastalarda Waters grafisi çekildi. Hastalar yaşlarına göre sınıflandırıldı. Erişkin grupta; ultrasonun maksiller sinüste sekresyon tespitinde %68 duyarlılık, %93 özgünlük ve %85 güvenilirliği; mukozal kalınlaşma tespitinde %95 duyarlılık, %92 özgünlük ve %93 güvenilirliği; kistik lezyonların tespitinde %66 duyarlılık, %86 özgünlük ve %84 güvenilirlik vardı. Çocuk grubunda; ultrasonun maksiller sinüste sekresyon tespitinde %92 duyarlılık, %93 özgünlük ve %93 güvenilirliği; mukozal kalınlaşma tespitinde %50 duyarlılık, %97 özgünlük ve %95 güvenilirliği vardı. Maksiller sinüsün ameliyat bulguları Waters radyografisi ve ultrasonografi ile karşılaştırıldığında, A-mod ultrasonografi %94 duyarlılık ile maksiller sinüs hastalıklarının tanısında güvenilir bir tanı yöntemi olarak görünmektedir ve paranasal sinüs hastalıklarının tedavi ve takibinde yararlı bilgiler sağlamaktadır.

Anahtar Kelimeler: A- mod ultrason, Radiografi, Maksiller sinüs hastalıkları.

Paranasal sinus disease is one of the most important disease affecting the population. The symptoms and signs of the di-

sease mimic other upper respiratory tract infectious diseases. Therefore some difficulties can be faced in the diagnosis of the pa-

ranasal sinus diseases. A positive bacterial culture from aspirated sinus secretion is the most reliable method. This is an invasive method and requires cannulation the sinus to aspirate secretion. Noninvasive techniques such as transillumination, radiography and ultrasonography can also be used as a diagnostic method^(1,2,3).

Radiography is the most frequently used method for confirming the diagnosis of sinusitis. In general, four standart projections are used in the examination of paranasal sinuses. However Water's view radiography is the most popular technique. The radiographic findings are the presence of an air-fluid level, complete opacification, mucosal thickening or dome shaped mucocel. Radiographic mucous membrane thickening is a source of confusion. The greater the thickening of the mucous membrane, the more likely the presence of fluid⁽²⁾.

A-mode ultrasound is a simple, painless, noninvasive method and does not expose the patient to ionizing radiation. The diagnostic use of ultrasound energy is based on the reflection of pulsed ultrasound energy from the tissue boundaries of different acoustic nature. These reflections generate an electric current that is amplified and displayed on an oscilloscope screen. Ultrasound applied over the maxillary sinus results in various peaks on the screen, corresponding to patterns of soft tissue, bone, fluid air in focus^(4,5).

There are many reports in the literature about the use of A-mode ultrasound examination in the diagnosis of sinusitis. Recent reports provide different opinions. Some authors report good results⁽⁶⁾ and the others report disappointing results^(7,8). The concordance of ultrasonography and irrigation in maxillary sinusitis is reported to be 80% to 97% in adults and 94% in children^(4,10).

The aim of this study is to establish the correlation between A-mode ultrasonic examination and radiography of paranasal sinus and to detect the sensitivity, specificity, and confidence of the ultrasonography in the diagnosis of paranasal sinus disease.

Materials and Methods

This study consisted of 387 patients with suspected paranasal sinusitis. Clinical examination, Water's view and ultrasonography were performed on the first visit. Ultrasonography was performed immediately after clinical examination and Waters' view radiography was performed within 2 hours of clinical examination. Caldwell-Luc operation was performed on 33 cases within 2 or 3 days after clinical examination and ultrasonography.

The patients were classified into 2 different groups.

1. Group: Adult group including 582 maxillary sinuses (n=291). Mean age: 34.3, Maximum age: 62, Minimum age: 17.

2. Group: Children group including 192 maxillary sinuses (n=96). Mean age: 11, Maximum age: 15, Minimum age: 5.

Radiographic findings were classified as follows:

Mucosal thickening (3 to 6 mm or > 6mm), cystic shadow, a horizontal fluid meniscus in the sinus, or complete opacity.

Ultrasonography was performed on all patients using an A-mode ultrasonography*. The frequency of the probe was 3.5 MHz and the diameter was 10 mm. The patient sat in an otologic examination chair. This transducer was placed on the anterior wall of the sinus beneath the orbital margin and the sinus was examined. A good acoustical contact between the transducer and skin was secured with contact jelly.

* ATMOS Medizintechnik Gmb H

The image on the oscilloscope screen was frozen to obtain hard copies that were retained for interpretation.

The findings were retained for interpretation:

1) Normal echogram: Front wall echo < 1.5 cm.

2) Mucosal thickening: Front wall echo 1.5 to 3 cm.

3) Sinus fluid: Back wall echo 4 to 6 cm from maxillary sinus front wall or 2 to 3 cm from frontal sinus front wall.

4) Polyp or cyst: Double echo 4 to 6 cm from maxillary sinus front wall or 2 to 3 cm from frontal sinus front wall.

Ultrasound results were interpreted by one of two authors who was blinded to the Waters' view radiography results.

Sensitivity was calculated by dividing the number of positive ultrasound by the number of positive X-ray findings. Specificity was calculated by dividing the number of negative ultrasounds by the number of negative X-ray findings. Confidence was detected by dividing the sum of real positive ultrasounds and real negative ultrasounds to the sum of real positive X-rays and real negative X-rays.

Results

The results were investigated on 2 different groups. In the adult group sensitivity, specificity and confidence of the detection of the secretion, mucosal thickening and cyst of the maxillary sinus were assessed separately (Table 1). The sensitivity was 83% and the specificity was 94% and confidence was 87% for all subjects in the adult group. The ultrasound was positive for secretion in 127 of the 186 X-rays, for mucosal thickening in 288 of the 304 X-rays, for cyst in 42 of the 64 X-rays. The agreement between the A-mode ultrasound and X-ray was

higher in the detection of the mucosal thickening than others.

In the children group; sensitivity, specificity and confidence of the detection of secretion, mucosal thickening and cyst of the maxillary sinus were assessed (Table 2). The ultrasound was positive for secretion in 68 of the 74 X-rays, for mucosal thickening in 82 of the 86 X-rays, for cyst in 4 of 8 X-rays.

Thirty three maxillary sinuses with suspected sinusitis using Water's view radiography were explored and the findings were compared to X-rays and ultrasonography. In this group, pathological evaluation was available for 31 cases with the ultrasonographic examination. It has been assessed pathological findings in 31 of all 33 cases with the operation. According to the operation results; sensitivity, specificity and confidence of the ultrasound were 94%, 0% and 88% respectively (Table 3).

In the present study the total obliteration was a sign of secretion according to our and some authors' results⁽¹¹⁾, because of agreement between operation results of the total opacity showed cases and ultrasound and X-rays in 100% of the cases.

Discussion

Two basic types of ultrasonography are available for clinical use. A-mode ultrasonography is produced by a single sound beam that produces a linear display on the viewing monitor. In the B-mode ultrasonography, the probe emits multiple sound beams and the echoes are displayed in a two-dimensional cross-sectional image. In almost all ultrasound studies of the paranasal sinuses the A-mode has been used and its results were compared to the other diagnostic methods such as radiography of paranasal sinus, puncture and transillumination. However, Gianoli et al., compared the

Table-1: Sensitivity, specificity and confidence of the A-mode ultrasound compared to the radiography in the maxillary sinus group (582 maxillary sinuses).

	Secretion		Mucosal thickening		Cyst	
	No	%	No	%	No	%
Sensitivity	127/186	68	288/304	95	42/64	66
Specificity	370/396	93	256/278	92	448/518	86
Confidence	497/582	85	544/582	93	490/582	84

Table-2: Sensitivity, specificity and confidence of the A-mode ultrasound compared to the radiography in the pediatric maxillary sinus group (192 maxillary sinuses).

	Secretion		Mucosal thickening		Cyst	
	No	%	No	%	No	%
Sensitivity	68/74	92	82/86	95	4/8	50
Specificity	110/118	93	100/106	94	178/184	97
Confidence	178/192	93	182/192	95	182/192	95

Table-3: Comparison of the radiography, ultrasonography and operation findings in the maxillary sinus (33 cases).

	Operative group		Ultrasonography			
	n		Positive		Negative	
			n	%	n	%
Positive	31		29	94	2	6
Negative	2		2	100	0	0
Total	33					

Sensitivity : $29/31 = 94\%$ Specificity : $0/2 = 0\%$ Confidence : $29/33 = 88\%$

B mode ultrasonography with computed tomography findings and reported that sensitivity and specificity of the ultrasonography were 100% and 98% respectively⁽¹²⁾. Mann et al., in 1977, correlated the sonographic findings with the results of irrigation, X-rays, sinuscopy and sinomanometry and found it correct in 90% of the cases⁽¹⁰⁾. Recently Revonta and Suonpaa reported agreement between puncture and sonography⁽⁴⁾. Previous correlations between X-rays and maxillary aspiration have demonstrated as 83% to 100% presence of secretion when X-ray demonstrates near total opacification or air-fluid levels⁽¹³⁾.

Landman, compared A-mode ultrasonography of the maxillary sinus with X-ray, clinical finding, irrigation or pathology⁽⁶⁾. He found the sensitivity and specificity for ultrasound 100% and 99% respectively. In another study, A-mode ultrasonography was found significantly more reliable than X-ray⁽¹⁴⁾. Revonta and Kuuliala studied the use of A-mode ultrasonography and Waters' view radiography in the diagnosis and follow-up eighty-five children with acute maxillary sinusitis using clinical findings as the control⁽²⁾. Concordance of ultrasonography and radiography was 91% on day 1, declined to 76% by day 20. Concordance with clinical findings on day 20 were 71% for radiography and 93% for ultrasonography. The authors concluded that ultrasonography reflects a return to normal sooner than radiography.

There can be false negative and positive findings in the ultrasound studies of the paranasal sinuses. False negative findings can be due to small amount of discharge, poor acoustical contact and technical failure of radiographic examination. False positive findings may be due to multiple reflections from the bone and air boundaries or the

transducer may be directed towards the orbit, laterally to the zygoma or to the mandible. It is of importance to examine the whole area of the sinuses in different directions and special care must be directed towards the bottom of the sinus in order to detect small amounts of secretion^(4,14).

The diagnostic value of ultrasonography in cases showing antral opacities in plain X-rays has been recognised by other workers, such as Berg and Carenfelt⁽¹⁵⁾; Edell and Isaacson found A-mode ultrasound most beneficial in differentiating opacification of the maxillary sinus radiographs due to technical or anatomopathologic condition⁽¹⁶⁾. Axellson et al. reported total radiographic opacity as a sign of secretion in 86% of cases⁽¹¹⁾, while Revonta found corresponding figures of 85% in adults and 75% in children⁽⁹⁾.

Mann et al.⁽¹⁰⁾ and Mann⁽¹⁷⁾ compared A-mode ultrasonography with an occipitofrontal projection in the diagnosis of the infant and adult sinusitis, but no trephine findings were reported. They found the absence of the bone wall echo in all of the radiographically normal sinuses and corresponding to 86% of the sinuses with a radiographic mucosal thickening in the adult group. It was also reported that radiographically normal 192 frontal sinuses were also normal in a scan⁽¹⁷⁾. A correlation between normal and abnormal findings of the two methods was detected in 67.5% of the infant group. Revonta found the confidence of A-mode ultrasonography in children 96%⁽¹⁸⁾.

These results agree with the results of the present study. In the adult group the confidence of A-mode ultrasonography has been found to be in 85%, 93% and 84% of the subjects in the detection of secretion, mucosal thickening and cyst respectively.

Especially there was the greatest success in the detection of the mucosal thickening of the maxillary sinus than the others. In the children group, the confidence of A-mode ultrasonography were 93%, 95% and 95% in the detection of secretion, mucosal thickening and cyst respectively. There was greater success in the detection of all pathological findings in the children group than in the adult group. In the operation group radiography and the ultrasound showed equal capability of separating diseases from non diseased sinuses. However the ultrasound was able to correctly detect different pathological conditions in 100% compared to 88% (29/33) cases with radiography in the same group.

The advantages of the diagnostic ultrasound are being noninvasive method without any known deleterious biological effect, rapid, painless, inexpensive and easily reproducible⁽¹⁹⁾. A-mode ultrasound examination is quite reliable method for the determination of pathological conditions within the maxillary sinus. These pathological conditions require therapy and follow-up. The A-mode ultrasound examinations can also be used to follow the response to treatment without x-ray exposure and it is a useful adjunct to the physical examination in the diagnosis and follow-up at sinusitis.

Conclusions

A-mode ultrasound is a rapid and safe screening test for maxillary sinusitis. Ultrasonography is particularly helpful in the children group and more informative in these situations being able to differentiate with greater accuracy between thickened mucosa, polyp or cyst and fluid. Ultrasonography seems to be a useful adjunct to the physical examination in the diagnosis and follow-up of sinusitis.

Geliş Tarihi: 04.09.1996

Yayına Kabul Tarihi: 22.10.1996

REFERENCES

1. Shapiro GG, Furukawa CT, Pierson WE, et al. Blinded comparison of maxillary sinus radiography and ultrasound for diagnosis of sinusitis. *J Allergy Clin Immunol* 1986; 77: 59-64.
2. Revonta M, Kuuliala I. The diagnosis and follow-up of pediatric sinusitis. Watersn'view radiography versus ultrasonography. *Laryngoscope* 1989; 99: 321-324.
3. Koyuncu M, Yağın Ş, Çelik O, et al. Kronik sinüs hastalıklarının tanısında sinüs endoskopisinin yeri ve önemi. *KBB Baş Boyun Cerrahisi Dergisi* 1993; 1: 228-231.
4. Revonta M, Suonpaa J, Diagnosis of subacute maxillary sinusitis in children. *J Laryngol Otol* 1981; 95: 133-140.
5. Fouad H, Khalfa MC, Labib T, et al. Diagnostic ultrasonography in maxillary sinus diseases. *J Laryngol Otol* 1984; 98:887-894.
6. Landman MD, Ultrasound screening for sinus disease. *Otolaryngol Head Neck Surg* 1986; 94: 157-164.
7. Carenfelt C. Antral aspiration. *Acta Otolaryngol* 1982; 93: 237-241.
8. Wald ER. Diagnostic considerations in pediatric sinusitis. *Pediatr Infect Dis J* 1985; 4 (6 Suppl.): 61-64.
9. Revonta M. Ultrasound in the diagnosis of maxillary and frontal sinusitis. *Acta Otolaryngol* 1980; 370: 1-55.
10. Mann W, Beck C, Apostotolidis T. Liability of ultrasound in maxillary sinus disease. *Arch Otorhinolaryngol* 1977; 215: 67-74.

11. Axellson A, Grebelius N, Chidekel N, et al. The correlation between radiological examinations and irrigation findings in maxillary sinusitis. *Acta Otolaryngol* 1970; 69: 302-306.
12. Gianoli GJ, Mann WJ, Miller RH. B-mode ultrasonography of the paranasal sinuses compared with CT findings. *Otolaryngol Head Neck Surg* 1992; 107: 713-420.
13. Rohr AS, Spector SL, Siegel SC, et al. Correlation between A-mode ultrasound and radiography in the diagnosis of maxillary sinusitis. *J Allergy Clin Immunol* 1986; 78: 58-61.
14. Jannert M, Andreasson L, Holmer NG, et al. A comparison between different ultrasonic display techniques, radiography and invasive control for different ultrasonic of the paranasal sinuses. *Acta Otolaryngol (Suppl)* 1982; 389: 29-52.
15. Berg O, Carenfelt C. Etiological diagnosis in sinusitis: ultrasonography as clinical complement. *Laryngoscope* 1985; 95: 851-853.
16. Edell SL, Isaacson S. A-mode ultrasound evaluation of maxillary sinus. *Otolaryngol Clin North Am* 1978; 11: 531-540.
17. Mann WJ. Die Ultraschalldiagnostik der ENH-Erkrankungen mit A-und B-scan. *Laryngo Rhino Otol* 1976; 55: 48-53.
18. Revonta M. A-mode of maxillary sinusitis in children. *Lancet* 1979; 1: 320.
19. Stosic S, Cvetinovic M, Jovic N, et al. Ultrasound as a diagnostic aid in maxillofacial surgery. *Dtsch Stomatol* 1991; 41:166-169.

