

Computed tomography scan of rhinosinusitis, current practice, and requirements for endoscopic surgery of paranasal sinuses

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ABSTRACT

الأهداف: تقييم الممارسات الحالية في طلب وعمل الأشعة المقطعية لمرضى عمليات جراحة الجيوب الأنفية بالتنظير الداخلي، بالإضافة إلى وصف الممارسات الحالية للمستشفيات في عمل الأشعة المقطعية.

الطريقة: أُجريت هذه الدراسة المقطعية الاستبائية في مدينة الحسين الطبية، عمان، الأردن وذلك خلال الفترة من أبريل إلى مايو 2010م. لقد قمنا بتصميم نماذج الاستبيان الثلاثة والتي كانت تستهدف الشرائح التالية: جراحوا الأنف والأذن والحنجرة، وأطباء الأشعة، وأقسام الأشعة في ثلاثة مستشفيات. صُمم النموذج الأول لأطباء الأنف والأذن والحنجرة وكان يهدف إلى معرفة ما إذا كانوا يقومون بإجراء عمليات التنظير الداخلي للجيوب الأنفية أم لا، وإذا كانت لديهم مواصفات محددة لعمل الأشعة المقطعية للجيوب الأنفية، وقد صُمم النموذج الثاني لأطباء الأشعة لمعرفة مواصفات عمل الأشعة المقطعية للجيوب الأنفية، وكان النموذج الأخير مُصمم لتقييم الممارسة الحالية لثلاثة مستشفيات في عمل الأشعة المقطعية للجيوب الأنفية.

النتائج: لقد شارك في هذه الدراسة 24 جراح أنف و أذن و حنجرة، وأشارت النتائج إلى أن 20 منهم (83.3%) كانوا يجرون عمليات الجيوب الأنفية بالتنظير الداخلي، و83.3% منهم يطلبون مواصفات محددة للأشعة المقطعية للجيوب الأنفية، وكان أكثر هذه المواصفات طلباً هو مستوى الصور التاجية (42%). وبالإضافة إلى الجراحين فقد شارك في هذه الدراسة 24 طبيب أشعة حيث كان 71% منهم يفضل وضعية الاستلقاء على البطن، و71% يفضلون مستوى الصور التاجية و71% يفضلون مستوى الصور التاجية المباشرة وليس المعاد تركيبها. أما المستشفيات الثلاثة التي تضمنتها الدراسة فقد كانت تعتمد مستوى الخط المحوري بالصور التاجية المعاد تركيبها وذلك بسمك الشريحة الذي يتراوح ما بين 2-3 ملم وكان مجموع عدد الصور من 40-50 صورة.

خاتمة: أظهرت الدراسة اختلافاً واضحاً في مواصفات عمل الأشعة الطبقيّة بين جراحي الأنف والأذن والحنجرة، وبين أطباء الأشعة، والمستشفيات فيما بينها وذلك بالمقارنة مع التوجيهات المنشورة في الأدب الطبي، لذلك نحن بحاجة إلى وضع بروتوكول توجيهي يتم الاتفاق عليه من أجل الحصول على أفضل المعلومات وأقل جرعة إشعاع ممكنة.

Objectives: To evaluate the current practice in requesting and performing paranasal sinuses CT scan for patients scheduled for endoscopic sinus surgery, and to describe the current hospital's practice in performing these scans.

Methods: This cross-sectional questionnaire study was conducted in the King Hussein Medical Center, Amman, Jordan between April and May 2010. Three forms were designed to collect data from our study groups, which included: Ear, Nose and Throat (ENT) surgeons, radiologists, and the radiology sections in 3 hospitals. The first was designed for ENT surgeons and aimed at investigating, whether or not they perform endoscopic sinus surgery, and if they have specific requirements for a CT scan of the sinuses. The second was designed for the radiologist to investigate their specifications in performing CT of the sinuses. The last was designed to evaluate the current practice of performing CT of the sinuses at the 3 hospitals.

Results: Twenty-four ENT surgeons participated, 83.3% surgeons performed endoscopic sinus surgery, and 83.3% requested specific specifications for the sinuses CT scan, and the most requested specification was coronal plane in 42%. Of the 24 radiologists, 71% prefer the prone position, 71% prefer the coronal plane, and 71% preferred direct coronal. In all 3 hospitals, the axial plane with reconstructed coronal images, the current practice with a slice thickness of 2-3 mm, and the total number of images was 40-50.

Conclusion: Differences between ENT surgeons, radiologists, and hospital's practice and other hospitals guidelines found in literature are present. Therefore, we are in need of an agreed upon guideline protocol to obtain the best data with the least radiation dose.

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Computed tomography (CT) scan is currently the most important radiological investigation of the paranasal sinuses. The advent of less invasive techniques of endoscopic sinus surgery has provided an important role for coronal CT of the paranasal sinuses, both as a diagnostic tool and for preoperative planning.¹ Radiation doses of conventional CT scans are usually underestimated by patients, physicians, and even radiologists,² but awareness of radiation risk is making its way into routine medical practice, and may play a larger role in future utilization review and pre approval regulations.³ Over the last 20 years, a search for the best protocol in performing these scans with the least radiation dose to reduce the amount of radiation with the maximum information was extensive.⁴ Many protocols were published and different reports produced with the best possible guidelines to reduce the amount of radiation with the maximum information. In Jordan, there is no agreed upon protocol, and the scan protocol is usually individualized according to the preference of the radiologist and/or the Ear, Nose and Throat (ENT) surgeon. Therefore, we conducted this study to evaluate the current practice in requesting and performing paranasal sinuses CT scans, and to describe the current hospital practice in performing these scans.

Methods. This is a cross-sectional questionnaire study, in which specially designed forms were used to collect data from the study groups including: ENT surgeons, radiologists, and radiology sections in 3 different hospitals. The first 2 groups represent different populations of doctors working in both private and public health sectors in our country to obtain a wider representation of current practice, and data collection was carried out during an ENT workshop organized as part of an international meeting and a radiology symposium organized at King Hussein Medical Centre between April and May 2010. The first form was designed for ENT surgeons, and our aim was to ascertain whether they perform endoscopic sinus surgery, since the paranasal sinuses CT scan is a mandatory preoperative investigation, and it provides the surgeon with the anatomic details he needs. The medical record abstract forms aimed to collect the following data: whether the surgeon ask for special specifications for the CT scan, what are these specifications, if they provide treatment before requesting the CT scan, what is the duration of treatment and when they perform the CT scan. The second form was designed for the radiologists and aimed to find out their specifications for the paranasal sinuses CT scans in regard to: the patient's position, plane, slice thickness, table increment, and the number of scan images, and at the end they were questioned on whether they prefer the direct coronal or the reconstructed

coronal images. The last form was designed to evaluate the current practice of performing paranasal sinuses CT scan at 3 different hospitals: King Hussein Medical Centre (KHMC), Prince Zaid Hospital (PZH), and Prince Rashid Hospital (PRH), Amman, Jordan, and we collected data regarding the following: the patient's position, plane, slice thickness, radiation dose (Kv and milliamperes-second [mAs]) and the number of scan images.

Results. Forty-eight doctors participated in this study, 24 ENT surgeons responded to the first form and we found that: 20 surgeons (83.3%) perform endoscopic sinus surgery, 20 (83.3%) ask for specific specifications while writing the request form, the coronal plane is the most requested specification 10 (42%), while 6 (25%) ask for axial and coronal planes, and 4 (16.7%) ask for specifications regarding slice thickness (thin slice thickness) (Table 1). Of the 24 radiologist involved in this study, 17 (71%) asked for prone position, 17 (71%) specified the coronal plane, 2-3 mm is the preferred slice thickness by 18 (75%) of the radiologists. There was a wide range in the number of scan images with the largest group, 8 (33%) asking for 40-50 images, and the direct coronal was preferred over reconstructed coronal in 17 (71%) (Table 2). Regarding the current practice of the 3 hospitals: the supine position, axial, and reconstructed coronal plane, and slice thickness 2-3 mm are shared by the hospitals. The radiation dose was the highest at the

Table 1 - The Ear, Nose, and Throat surgeons response in the specially designed record form (N=24).

Response	n	(%)
<i>Do you perform endoscopic sinus surgery</i>		
Yes	20	(83.3)
No	4	(16.7)
<i>Do you ask for CT scan specifications</i>		
Yes	20	(83.3)
No	4	(16.7)
<i>Do you give treatment before requesting CT scan</i>		
Yes	21	(87.5)
No	3	(12.5)
<i>Treatment duration</i>		
7-14 days	13	(54.0)
Not specified	11	(46.0)
<i>When to performs scan after treatment</i>		
<14 days	2	(8.0)
14-28 days	6	(25.0)
>28 days	2	(8.0)
Not specified	14	(59.0)
<i>CT specifications</i>		
Coronal	10	(42.0)
Axial	0	(0)
Axial and coronal	6	(25.0)
Not specified	4	(16.7)
Slice thickness	4	(16.7)

Table 2 - Radiologist response (N=24).

Response	n	(%)
<i>Patient position</i>		
Prone	17	(71.0)
Supine	7	(29.0)
<i>Plane</i>		
Coronal	17	(71.0)
Axial	4	(17.0)
Axial and coronal	3	(12.0)
<i>Slice thickness</i>		
2 mm	9	(37.5)
2.5 mm	4	(17.0)
3 mm	9	(37.5)
Not specified	2	(8.0)
<i>Table increment</i>		
2-2.5 mm	11	(46.0)
3-5 mm	5	(21.0)
5-10 mm	1	(4.0)
Not specified	7	(29.0)
<i>Number of scanned images</i>		
1-20 images	3	(12.0)
21-30 images	2	(8.0)
31-40 images	4	(17.0)
41-50 images	8	(33.0)
>50 images	2	(8.0)
Not specified	5	(21.0)
<i>Preference</i>		
Direct coronal	17	(71.0)
Reconstructed coronal	6	(24.0)
Either prone or supine	1	(4.0)

Prince Rashid Hospital with 440 mAs since it has the oldest CT scan machine, as shown in Table 3.

Discussion. Currently, the best radiological investigation for the evaluation of paranasal sinuses is the CT scan, as it displays both bone and soft tissue efficiently. The optimal CT technique for imaging the sinonasal complex is still a matter of debate.⁵ In our analysis, we noticed few differences between ENT surgeons and radiologists, between ENT surgeons in the same group, and between radiologists themselves. Although there are similarities in the current practice in our 3 hospitals, which might represent an unwritten protocol, they have major differences with other published protocols, such as the John Hopkins Hospital (Baltimore, Maryland, USA),^{1,5} the Royal National Throat Nose Ear Hospital (RNTNE),⁶ and the Charing Cross Hospital (London, United Kingdom).⁷ Table

Table 5 - Suggested protocol.

Plane	Direct coronal + Axial
Slice thickness	4 mm (2 mm through ostiomeatal complex)
Increment	3 mm
Scan images	12-16 coronal 6-8 axial
Radiation	kV 120 , mAs 60-100

Table 3 - Current practices of the 3 hospitals.

Practice	KHMC	PZH	PRH
Patient position	Supine	Supine	Supine
Plane	Axial and coronal	Axial and coronal	Axial and coronal
Slice thickness	2.5 mm	2 mm	2.5 mm
<i>Radiation</i>			
kV	120	120	120
mAs	60	90	440
No. of scanned images	40-50	45-50	40

KHMC - King Hussein Medical Centre, PZH - Prince Zaid Hospital, PRH - Prince Rashid Hospital

Table 4 - Published protocols.

Protocols	John Hopkins Hospital ^{1,5}	Charing cross ⁷	RNTNE ⁶
Plane	Direct coronal	Direct coronal	Direct coronal
Slice thickness	4 mm	2 mm	5 mm (2.5 mm through OMC)
Increment	Contiguous	8 mm	Contiguous
Scan images	20-25	10+ 2 axial	18-20
Radiation	120 kv, 80 mAs	120 kv, 200 mAs	120 kv, 100 mAs

OMC - ostiomeatal complex, RNTNE - Royal National Throat, Nose, and Ear Hospital

4 represents the current protocols for these hospitals. Some consider that direct coronals are a pre-requisite to virtually all protocols, even with the advent of the fast spiral scanners, which have considerably improved the quality of reconstructed images, both the axial and the sagittal.⁶ However, it is not uncommon for departments to continue using the same protocol utilized for early scanners.⁸ The coronal plane is the plane closest to the view of the endoscopist, it is also the imaging plane that displays the ostiomeatal unit.¹ One of the major disadvantages of direct coronal is that it requires prone positioning for a prolonged period,⁹ and when patients are unable to assume the prone position, the reconstructed coronal can be used.¹ In children, the sinuses CT scan demonstrates an excellent diagnostic accuracy,¹⁰ and others have suggested that CT scan may help identifying patients with allergic fungal sinusitis,¹¹ and invasive fungal sinusitis.¹² The radiation dose to the lens of the eye and the thyroid gland in the paranasal sinuses CT scan is of concern, as it might cause cataracts, and it has a cumulative effect. Studies have shown that this radiation dose is significantly lower in the axial than the coronal plane.¹³ Recent studies proved that sinus CT scans can be performed in patients prior to endoscopic surgery at greatly reduced mAs without loss of diagnostic quality of the images,^{8,14} nor technical registration accuracy for navigation.¹⁵ This should be carried out paying attention to the capability of the CT scanners. However, it might not be applicable in all case as some have proposed that low-dose scanning should not be used when soft-tissue contrast is an issue, as in the case of tumor surgery.¹⁵

The limitation of our study is that different CT machines types differ in their images quality, which might be dependent on the dose of radiation, therefore, protocols might not be applicable to all scanners. It is hoped that CT manufacturers will soon begin to provide more accurate patient-specific doses as part of the archived information to aid future longitudinal dose monitoring efforts.¹⁶ Table 5 shows a suggested protocol to be adopted by our group of hospitals. In this protocol we have added axial scans, as we think they gave us the third dimension needed prior to surgery. In addition, axial scans optimally demonstrate the relationship between the posterior ethmoids and sphenoid to the optic nerve and the carotid artery.⁶

In conclusion, although we have seen intra and inter differences in our study groups, we recommend a meeting between ENT surgeons and radiologists to produce an agreed upon protocol taking into consideration the requirements of the ENT surgeons,

the lowest radiation dose that can provide the necessary information, and the minimum number of scan images to reduce expenses.

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