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MAIN ARTICLE

Improving paranasal sinus computed tomography reporting prior to functional endoscopic sinus surgery – an ENT-UK panel perspective

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Abstract

Background: Functional endoscopic sinus surgery is recognised to have a significant complication profile (e.g. blindness, cerebrospinal fluid leak and intracranial sepsis). Pre-operative computed tomography imaging is considered mandatory for surgical planning to reduce intra-operative risk. A radiological report is the 'gold standard' in image interpretation; however, because of a lack of otolaryngological or radiological guidance, its contents may be variable. By surveying practising otolaryngologists, this study aimed to provide some guidance which may be used by radiologists to produce more surgically relevant radiological reports.

Method: A prospective questionnaire was distributed to the ENT-UK panel.

Results: A total of 117 consultant members of the panel completed the survey. Twenty-nine per cent indicated that they were uncomfortable interpreting all areas of the computed tomography scan. Greatest importance was given to areas including the ethmoid roof (dehiscence, asymmetry and angle), lamina papyracea (dehiscence) and sphenoid sinus (carotid canal dehiscence and optic nerve relationships).

Conclusion: Functional endoscopic sinus surgery is commonly performed by non-subspecialist rhinologists. The information obtained from this study can be used by radiologists to improve report relevance, particularly for the generalist ENT surgeon. This contributes to improving patient safety and helps avoid medicolegal litigation when complications arise.

Key words: Tomography; X-Ray Computed; Medicolegal Aspects; Natural Orifice Endoscopic Surgery; Sinusitis; Perioperative Care

Introduction

Functional endoscopic sinus surgery (FESS) is now widely accepted to be the primary surgical intervention for sinonasal inflammatory disease.[1] One of the key prerequisites for performing successful and safe surgery is a thorough knowledge of the paranasal sinus anatomy. Despite this knowledge, unusual anatomical variants, previous surgery and severe disease may lead to more hazardous conditions, putting the patient at risk of potentially catastrophic complications.

Computed tomography (CT) scans of the paranasal sinuses are now regarded as mandatory prior to FESS, as they provide accurate information regarding disease extent and detailed anatomy.[2] Anecdotal evidence suggests that in the UK, the majority of surgeons who request CT scans of the paranasal sinuses interpret the images themselves prior to surgery. However, no formal study has confirmed this practice. Publicised radiological standards make reference to the importance of expert reporting of all radiological images.[3] Expert reporting may identify disease or important anatomical variants that might otherwise be missed by those without a radiological background or by those who do not perform a high volume of FESS procedures. In rare circumstances, ignoring the findings of a formal radiological report can leave clinicians open to medicolegal litigation in the event of operative complications.

The level of anatomical detail provided in a radiology report has been shown to differ significantly in practice.[4] This may in part be related to differences in the expectations of the perceived use of paranasal sinus CT scans between radiologists and otolaryngologists. Otolaryngologists predominantly request paranasal sinus CT as a 'road map' to identify surgically relevant anatomy, rather than for assessing disease extent. A lack of understanding of the specific surgical needs by the reporting radiologists may lead to suboptimal reports that are inadequate for operative planning,

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especially for those less comfortable with interpreting CT images themselves.

Several 'checklists' have been published that highlight key anatomical areas within the paranasal sinuses.[5–7] To date, there are no published (radiological or ENT) guidelines for the interpretation of paranasal sinus CT scans performed specifically for peri-operative planning. This study therefore aimed to ascertain the opinions of practising UK otolaryngologists regarding identifying important surgically relevant areas to be described within a radiological report, which could be used to improve pre-operative planning and safety.

Materials and methods

A review of the literature was performed by searching databases that included Medline, PubMed and Embase for the following keywords: endoscopic sinus surgery, computed tomography (CT), anatomy and paranasal sinuses. Current evidence relating to key areas in surgical and radiological sinonasal anatomy[2,8,9] was retrieved and used to develop a questionnaire (Table I).

The survey aimed to address two main questions: (1) how comfortable are UK otolaryngologists at interpreting CT scans of the paranasal sinuses themselves; and (2) what areas are considered important for radiologists to make a formal comment upon within their report.

Each question regarding individual anatomical areas requested a response on a five-point scale, which reflected varying degrees of importance, with a score of 1 representing unimportant and 5 reflecting vitally important (Table II).

After an initial local pilot study assessing the appropriateness of the questionnaire, the survey was edited and approved by the ENT-UK Survey Guardian prior to distribution. It was circulated via e-mail invitation to the ENT-UK panel, the British Association of Otorhinolaryngology – Head and Neck Surgery, between October 2013 and November 2013. The results for each question were collated and statistically analysed (chi-square analysis) using SPSS® version 17.0. Statistical significance was defined as $p < 0.05$.

TABLE I
KEY ANATOMICAL AREAS OF PARANASAL SINUSES*

Ethmoid sinus
– Roof dehiscence
– Roof height & asymmetry
– Lamina papyracea dehiscence
– Uncinate process attachments & relationships
– Anterior ethmoidal artery position
Middle turbinate
– Presence & attachments
– Presence of variants
Frontal sinus
– Frontonasal recess configuration
Maxillary sinus
– Infraorbital cell presence
Sphenoid sinus
– Sphenoethmoidal cell presence
– Carotid artery dehiscence
– Relationship or prominence of optic nerve to cells

*Developed from Lund *et al.*[2]

Results

Questionnaire invites were sent to 332 members of the ENT-UK panel. From these, there were 117 (35.2 per cent) fully complete responses. Responders to the survey included: consultants (84 per cent), specialty trainees (7 per cent), associate specialists (6.1 per cent) and others (2.9 per cent). The average experience in otolaryngology was 19.82 years (range, 6–40 years). From the consultant group, 42 per cent were subspecialist rhinologists.

Twenty-nine per cent of the consultant clinicians stated that they were not comfortable analysing all anatomical areas in question on CT imaging. In addition, 39 per cent admitted to feeling uncomfortable in operating within certain anatomical areas during FESS without a formal radiological report. The subgroup analysis showed that the non-rhinologist group were less comfortable in interpreting all areas of the CT scan compared to the rhinologist group ($p = 0.015$).

Importance of anatomical areas

Detailed responses for the questionnaire are shown in Table II. Anatomical areas graded with the highest importance (5 out of 5) included the carotid canal and ethmoid roof (dehiscence of both), and the optic nerve and its relationship to accessory air cells. Anatomical areas graded 4 out of 5 and labelled 'very important' included the lamina papyracea (dehiscence) and the ethmoid roof (asymmetry and anteroposterior angle). Anatomical areas graded 3 out of 5 and labelled of 'average importance' included the anterior ethmoidal artery (its position), sphenoethmoidal (Onodi) cells (their presence), the frontonasal recess (configuration), the uncinate process (attachments and relationships), infraorbital (Haller) cells (their presence), the middle turbinate (presence and attachments) and middle turbinate variants. There was agreement between the two subgroups (rhinologists and non-rhinologists) when grading the vast majority of anatomical subsites.

Discussion

Computed tomography imaging is essential in identifying patient-specific paranasal sinus anatomy pre-operatively, to enable safe and efficient surgery. Our study highlights the surgically relevant anatomical areas identified by UK otolaryngologists.

Formal radiological reporting is considered to be the 'gold standard' in image interpretation; however, limited evidence suggests that the content can be variable[4] and is not always used by the operating clinician. This practice may have several important implications relating to possible medicolegal consequences, and may have an impact upon radiological services and inter-departmental relationships.

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TABLE II
IMPORTANCE OF INDIVIDUAL ANATOMICAL AREAS OF PARANASAL SINUS COMPUTED TOMOGRAPHY TO BE REPORTED

Anatomical site	Degree of importance				
	1 (unimportant)	2	3 (of average importance)	4	5 (vitally important)
Ethmoid sinus					
– Roof dehiscence	12.0 (14)	5.1 (6)	15.4 (18)	25.6 (30)	41.9 (49)*
– Lamina papyracea dehiscence	14.2 (16)	7.1 (8)	22.1 (25)	30.1 (34)*	26.5 (30)
– Roof asymmetry & angle	16.2 (19)	6.8 (8)	25.6 (30)	30.8 (36)*	20.5 (24)
– Anterior ethmoid artery position	16.2 (19)	12.0 (14)	35.0 (41)*	26.5 (31)	10.3 (12)
– Uncinate process attachments & relationships	20.5 (24)	20.5 (24)	27.4 (34)*	25.6 (30)	6.0 (7)
– Ethmoid bulla size & pneumatisation	31.6 (37)	32.5 (38)*	26.5 (31)	7.7 (9)	1.7 (2)
Middle turbinate					
– Presence & attachments	25.0 (27)	26.7 (31)	28.4 (33)*	18.1 (21)	1.7 (2)
– Presence of variants (e.g. concha bullosa)	27.6 (32)	31.0 (36)	35.3 (41)*	5.2 (6)	0.9 (1)
Frontal sinus					
– Frontonasal recess configuration	17.9 (21)	19.7 (23)	32.5 (38)*	27.4 (32)	2.6 (3)
– Frontal sinus size, shape & septa	24.6 (28)	36.0 (41)*	26.3 (30)	13.2 (15)	0.0 (0)
Maxillary sinus					
– Infraorbital (Haller) cell presence	22.2 (26)	23.1 (27)	30.8 (36)*	20.5 (24)	3.4 (4)
– Infundibulum width	37.6 (44)*	34.2 (40)	22.2 (26)	5.1 (6)	0.9 (1)
– Maxillary sinus size & shape	37.1 (43)	42.2 (49)*	12.1 (14)	8.6 (10)	0.0 (0)
Sphenoid sinus					
– Carotid artery dehiscence	7.8 (9)	5.2 (6)	20.9 (24)	26.1 (30)	40.0 (46)*
– Relationship of optic nerve to cells	11.2 (13)	5.2 (6)	21.6 (25)	25.9 (30)	36.2 (42)*
– Sphenoethmoidal (Onodi) cell presence	16.4 (19)	21.6 (25)	28.4 (33)*	22.4 (26)	11.2 (13)

Data represent the importance of each anatomical area, in terms of percentages (and numbers) of responders. *Indicates the grade (1–5) given by the highest percentage (numbers) of responders

Medicolegal implications

Medical malpractice cases linked to FESS have become more commonplace. Lynn-Macrae *et al*. performed an analysis of the US legal database, assessing FESS-related litigation from 1990 to 2003.[10] They reported that 76 per cent of malpractice cases were allegedly a result of negligent technique, with the highest payouts being awarded to those with disabilities from blindness, diplopia, anosmia, cerebrospinal fluid leak and brain damage.

These specific complications arise from damage to the skull base or orbit. Severe sinonasal disease or variable anatomy may be significant contributory factors in accidental damage to these areas. Therefore, from the medicolegal perspective, inadequate pre-operative planning (e.g. failure to appreciate endogenous risk factors in patients, such as variable anatomy on a CT scan) may be perceived as contributing to negligent technique. Further analysis has shown that these patient factors (e.g. variable anatomy) have a stronger relationship with the risk of such complications compared to surgical factors (e.g. technique and experience).[11]

Burden for radiologists

Radiological services within the UK are coming under increasing pressure, with a growing annual workload of the order of 2–5 per cent per annum.[11,12] In 2002, the Royal College of Radiologists' publication *Clinical Radiology: a Workforce in Crisis* highlighted the increased workload of the consultant radiologist.[13] Plans to include additional commitments such as multidisciplinary team working has meant that there is a greater need for rationalisation of the time committed to image reporting. Guidance published by the Royal College of Radiologists recommends that numbers of CT and magnetic resonance imaging scans to be reported by radiologists should be at three to six per hour for standard scans and at one to two per hour for complex scans,[14] thus giving an estimate of the potential burden for the reporting of sinus CT scans.

The average growth rate of CT image requests has been shown to be in the order of 10.1 per cent per annum since 2003.[12] Therefore, in the context of greater CT scan reporting and an increasing workload, it is more important than ever that radiologists spend their time reporting on images that really make a difference to surgery and patient safety.

What our survey says

The majority of specialists within our study (70.1 per cent) indicated that they are fully confident in interpreting all of the anatomical sites within the CT scan. A notable number of consultant clinicians (39 per cent) stated that they would not feel comfortable operating in certain anatomical areas without a formal radiological report. These findings may reflect varying experience (within consultant clinicians) in the UK in performing FESS. It is likely that more complex cases (e.g. frontal sinus or sphenoid disease) are commonly referred onto subspecialists who deal with

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larger caseloads. Subspecialist rhinologists and FESS surgeons represented 42 per cent of the study group, which suggests that the findings from our study reflect the opinions of a wider range of ENT clinicians, including the generalist, all of whom commonly perform FESS in the UK.

Despite the anecdotal opinions, our survey of the ENT-UK panel indicates that there is diversity in the peri-operative strategy for those performing FESS in the UK. When surveying a sizeable number of practising UK otolaryngologists (with an average time in practice of 19.82 years; range of 6–40 years), this study identified an ongoing need for a formal radiological report for a significant number of clinicians performing FESS. Unsurprisingly, it is likely that the greatest benefit of formal reporting may come to those who are not subspecialist rhinologists, and are therefore less confident operating in certain areas (e.g. frontal sinus or sphenoid sinus), especially if they are not planning to refer the case onwards.

This study identified key anatomical areas that hold greater importance to otolaryngologists (Table III). Unsurprisingly, the sites identified represent areas that harbour risk of catastrophic complications relating to the orbit and skull base.

The study attempts to ascertain the importance of a potential comment about a specific anatomical subsite within a formal radiological report. This does not reflect the importance of the anatomical area per se. This may explain why a number of participants (n = 9) labelled all areas with 'no importance' to be reported by the radiologist. Reasons cited by clinicians for this pattern of response included their own comfort in interpreting all aspects of the CT scan alone and the subsequent lack of need for using the radiologist's report. These clinicians were predominantly subspecialist rhinologists. This finding highlights a limitation of the study design that requires all participants to undertake the main body of the questionnaire despite stating they did not use a radiologist report. Twenty-seven of the participants who stated they were comfortable in analysing all areas of a CT scan continued to rate the importance of individual anatomical areas. Therefore, all responses were included in the final analysis.

The inclusion of primary and revision surgery within the survey may be regarded as a further limitation. Feedback suggests that experts consider radiological reporting to have greater importance in revision cases. However, it could be argued that peri-operative planning for any surgery (primary or revision) should be consistent in order to reduce any undue risk of medical negligence. Production of this particular questionnaire required a concise structure that followed strict production and dissemination guidelines (ENT-UK[15]). For this study, addressing the limitations already described with regard to survey design and separation of primary and revision surgery would have significantly prolonged the questionnaire, and thus impacted upon participant engagement.

TABLE III
CHECKLIST OF KEY AREAS*

Ethmoid sinus
– Ethmoid roof dehiscence†
– Ethmoid roof asymmetry & skull base angle‡
– Lamina papyracea dehiscence‡
– Anterior ethmoidal artery position**
– Uncinate process attachments & relationships**
Middle turbinate
– Presence & attachments**
– Presence of variants**
Maxillary sinus
– Infraorbital (Haller) cell presence**
Frontal sinus
– Frontonasal recess configuration**
Sphenoid sinus
– Carotid artery dehiscence†
– Relationship or prominence of optic nerve to air cells†
– Sphenoethmoidal (Onodi) cell presence**

*These represent the key areas to be commented upon within a formal radiological report. †Vitally important; ‡very important; **important

- **Paranasal sinus computed tomography is essential for pre-operative planning of functional endoscopic sinus surgery**
- **Radiological reports may be variable because of the lack of published guidance**
- **Key anatomical areas identified by ENT-UK panel are described**
- **This study may be used to produce surgically relevant radiological reports**

The results from this study may be utilised as an aide memoir to guide radiologists producing reports for paranasal sinus CT; the findings highlight those surgically relevant anatomical areas identified as important by UK otolaryngologists that should be included within such reports (Table III).

Conclusion

To our knowledge, this is the first study to obtain formal guidance from a group of practising otolaryngologists regarding surgically relevant areas considered important for description within a radiology report. The information gleaned from this study can be used to guide radiologists who report paranasal sinus CT findings, to improve peri-operative surgical planning and ultimately safety. In an age of increasing medicolegal litigation, such information may help to reduce the risk of medical negligence claims.

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