ORIGINAL CONTRIBUTION

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Predicting the site of attachment of sinonasal inverted papilloma*

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SUMMARY

Statement of problem: *Sinonasal inverted papilloma is a benign, epithelial neoplasm, which has a propensity for malignant transformation and recurrence. The evolution of endoscopic trans-nasal surgery has facilitated less destructive and, more functionally and cosmetically acceptable approaches to this tumour. Recurrence rates have been shown to be more favourable than after traditional external approaches. Precise surgery is enhanced by pre-operative localisation of the site of tumour attachment. The aim of this study was to examine, in a prospective fashion, the predictive value of osteitis on the pre-operative CT scan of the paranasal sinuses at correctly identifying the site of attachment of sinonasal inverted papilloma.*

Method of study: *Pre-operative CT scans of the paranasal sinuses in 24 patients with histology-proven sinonasal inverted papilloma were examined for osteitis, allowing a prediction of the site of attachment. Coronal reformats of thin-cut (1mm) axial CT scans were evaluated. Intra-operatively, the actual site of tumour attachment was established. A correlation between the predicted and actual site of tumour attachment was calculated.*

Main result: *The predictive value of the osteitis sign was 95%.*

Principal conclusion: *Pre-operative identification of osteitis can be used in 95% of cases to accurately predict the intra-operative site of attachment of sinonasal inverted papilloma.*

Key words: sinonasal, inverted papilloma, osteitis, attachment, endoscopic sinus surgery

INTRODUCTION

Sinonasal inverted papilloma (SNIP) is a benign neoplasm of epithelial origin, but which unfortunately has an association with both synchronous and metachronous carcinoma [1,2]. Fortunately, the disease is rarely multicentric, with a single focus being most likely, a feature that lends itself to targeted endoscopic management.

The site of attachment of SNIP is paramount in planning surgical resection. The 'classical' early descriptions of its management involved open approaches, en-bloc resections, and extensive mucosal stripping in ipsilateral sinuses [3]. This ethos was re-iterated in the mid-1990s [4]. However, soon after this time, with the evolution of endoscopic trans-nasal techniques, minimally-invasive and more focussed endoscopic resection of SNIP was shown to bestow more favourable recurrence rates [5,6]. Indeed, as techniques have become more refined and instrumentation improved, endoscopic resections are now associated with a lower rate of recurrence than traditional open procedures [7].

It is widely accepted that a single focus and site of attachment is typical of SNIP, and that multicentricity is, fortunately, rare [1]. Consequently, endoscopic surgical resection entails debulking of macroscopic tumour to the point of origin, which is then dealt with in the most appropriate manner. However, the ability to identify this point of attachment pre-operatively would facilitate accurate pre-operative planning including duration of surgery, enhance the pre-operative discussion with the patient and informed consent, and enable a precise surgical resection.

Earlier studies have identified consistent changes on the pre-operative CT scans of patients with SNIP [8,9]. The osteitis sign and neo-osteogenesis have been shown, in a retrospective study, to be reliable markers of the site of attachment of SNIP. Osteitis describes inflammatory changes of bone with resultant radiologic findings of bone thickening and neo-osteogenesis (Figure 1A-B). The phenomenon has been theorized to occur as a result of the interaction between osteoblastic and osteoclastic activity at the site of bony inflammation. The presence of osteitis was documented in 90% of pre-operative CT scans in SNIP and, accurately predicted the site of attachment of the tumour in 89% of cases. This was, however, a retrospective case file and CT image analysis [10].

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The aim of this study was to prospectively document the reliability of the osteitis sign at predicting the site of attachment of SNIP.

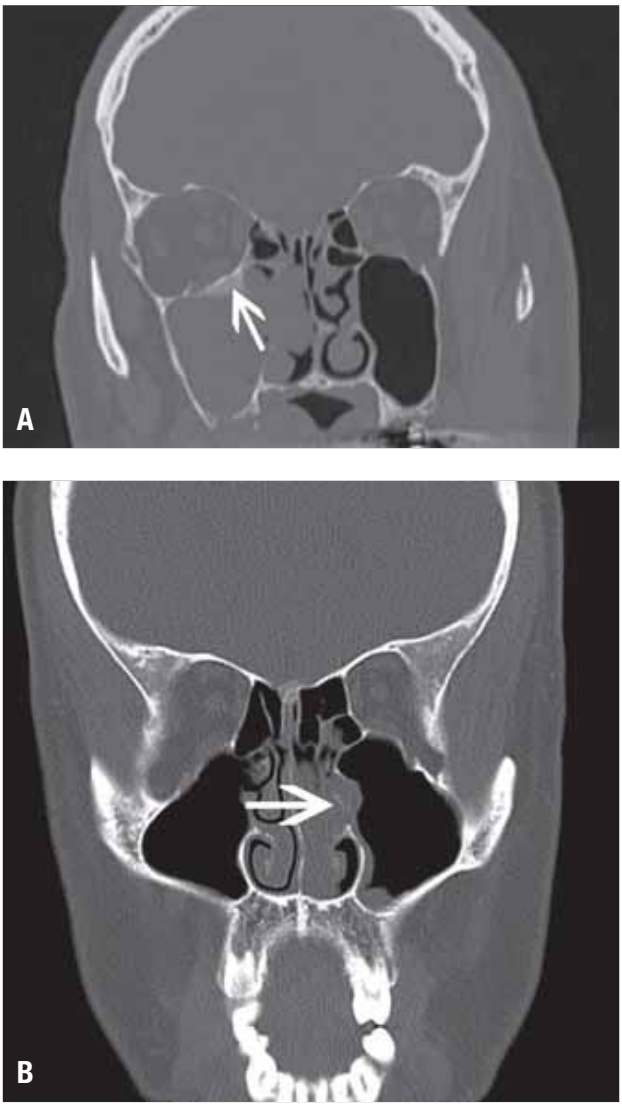

Figure 1. Coronal computed tomogram showing A) Obvious, and B) Subtle, osteitis at the site of attachment of a sinonasal inverted papilloma. Intermediate osteitis is displayed in Figure 2.

METHODS

Design

Prospective, evaluator-blinded observation of case series.

Setting

Alberta Sinus Centre, University of Alberta Hospital, Edmonton, Alberta, Canada.

Participants

Twenty-four consecutive patients with primary, occult or recurrent SNIP.

Ethical considerations

The study design and protocol was approved by the Health Research Ethics Board of the University of Alberta and Capital Health (Protocol #6949).

Main outcome measures

All patients had pre-operative paranasal sinus CT scans. The CT scan protocol for these studies employed a thin-cut (1mm) axial scan with coronal reformats. The presence of osteitis and its degree was assessed. The degree of osteitis was recorded as subtle, intermediate or obvious (Figure 1A-B). Readily discernible osteitis was used as our baseline and reference point and, was termed intermediate. Intense and extensive osteitis was termed obvious, and reflected a greater degree of osteitis than intermediate. Finally, osteitis that was not readily discernible, but rather required more careful scrutiny and comparison between the ipsi- and contra-lateral sides to detect, was termed subtle. Using this system, a prediction as to the site of attachment of the SNIP was made (Figure 2).

The assessment of the point of origin of the SNIP was made primarily from the coronal views. Conventional bone windows may be used to assess the CT scans and, are generally recommended to be a window-width (W) of +1500-2000HU, with a negative centre (C) of -150HU. However, we found that standard windowing of W = +1800 and C = +350 was effective and thus, would suggest this for identification of the osteitis / neo-osteogenesis sign. All cases were managed endoscopically, with the surgery performed by a single surgeon. Two independent observers agreed on the site of attachment intra-operatively (Figure 3). The predicted site of attachment was then correlated with the actual site of attachment.

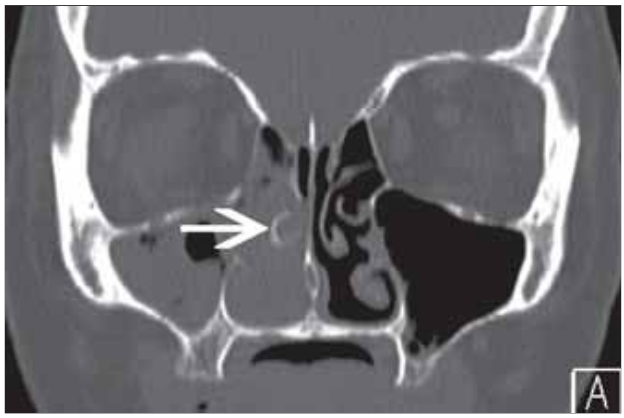

Figure 2. Pre-operative CT scan predicting the site of attachment of an inverted papilloma to the right middle turbinate, displaying intermediate osteitis (arrow).

RESULTS

Twenty-four consecutive patients were recruited to the study, 14 males and 10 females. The mean age at presentation was 49.4 years (range 29 to 73 years). Seventeen patients had primary SNIP, 5 had occult disease, and 2 had recurrent disease.

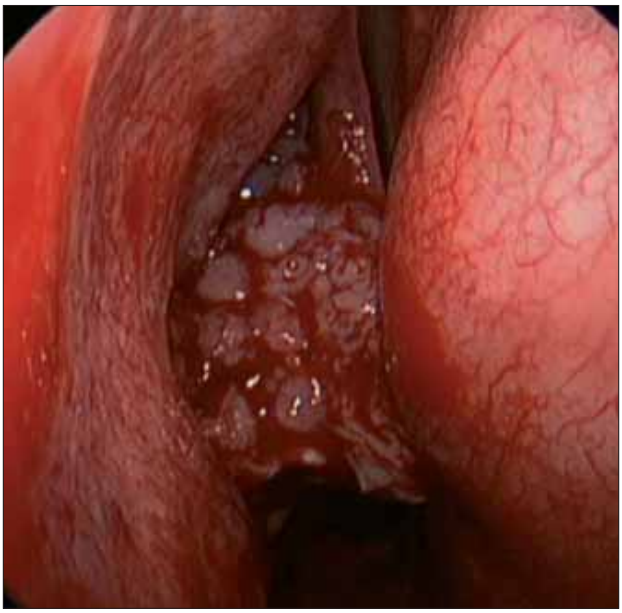

Figure 3. Endoscopic intra-operative digital photograph showing middle turbinate attachment of inverted papilloma.

Osteitis was identified in 21 of 24 cases pre-operatively (88%). This was obvious in 7 cases, intermediate in 10 cases, and subtle in 4 cases. On the basis of this detection, a pre-operative evaluation was made on the probable site of attachment of the SNIP. The site of attachment was predicted to be one of several very specific sites, which included the ethmoid bulla, middle turbinate, uncinate process, frontal recess, specific sites within the maxillary antrum, lamina papyracea, and nasal septum.

The actual site of attachment of the SNIP, identified intra-operatively, was correctly predicted in 20 of the 21 cases where osteitis was detected pre-operatively. The predictive value of the osteitis sign was 95%.

DISCUSSION

Sinonasal papilloma is a benign neoplasm of epithelial origin and, occurs most commonly in the 6th to 8th decade of life. Three subtypes are recognised: cylindrical (5%), exophytic fungiform (34%), and inverted (61%) [11]. The inverting subtype (Figure 4) has a male preponderance and fortunately, bilateral disease occurs in fewer than 10% of cases. However, there is an association with synchronous cancer in 10% [12]. Commonly accepted aetiological factors include the high-risk subtypes of the human papilloma virus [13], over-expression of p53 and Ki67 [14,15], and inflammation [11].

A shift towards endoscopic management of SNIP with preservation of unaffected mucosa [16] has highlighted a need for a more accurate pre-operative assessment of the site of attachment. This allows surgery to be sequentially coned down to the site of attachment, with a much more focussed approach at the point of origin and thankfully, moving away from the extensive mucosa-stripping techniques of former years.

Osteitis and neo-osteogenesis at the site of attachment of SNIP is thought to occur as a consequence of the local action of cytokines released presumably, by the abundant associated inflammatory infiltrate [11]. Since cytokines influence osteoblast function, they are thought to promote neo-osteogenesis secondary to osteitis. Several retrospective studies have now corroborated the value of identifying bony changes on pre-operative CT scans of the paranasal sinuses as a measure of localising the point of attachment of SNIP intra-operatively [10,17,18]. The predictive value ranged from 89 to 100% in these studies.

Our study is the first prospective and blinded evaluation examining the osteitis sign and its value in identifying the site of attachment of SNIP, correctly predicting attachment in 95% of cases when the sign was present. This study was not designed to assess the usefulness of the osteitis sign in reducing recurrence rates. To properly evaluate recurrence rates would require follow-up data of 3-5 years. The authors do appreciate, however, that this is a valuable observation to report and, will continue to follow this cohort of patients long-term for future reporting.

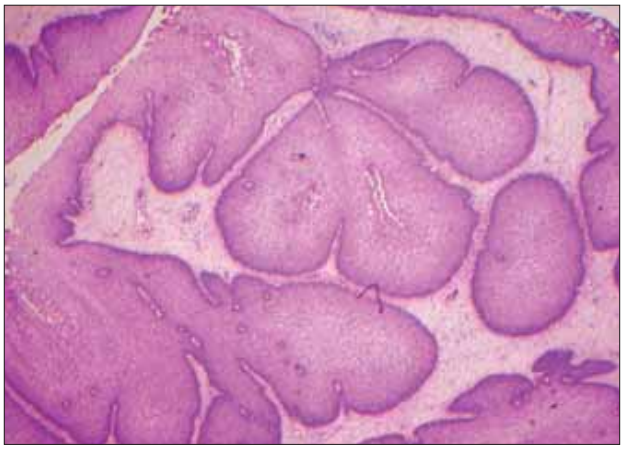

Figure 4. Photomicrograph of a sinonasal inverted papilloma displaying the classical endophytic growth pattern typical of these lesions.

As already alluded to, the ability to explicitly identify the site of attachment of SNIP during the pre-operative assessment facilitates accurate pre-operative planning of the surgical resection and hence, time management; supplements the pre-operative discussion with the patient and, of course, informed consent; and precludes unnecessary mucosal injury during the precise surgical resection. The extent of the lesion was defined simply using the CT scan and clinical examination with the endoscope. The site of attachment was predicted by the radiologic hyperostosis/osteitis at the site of attachment. We have routinely found that while the tumour may extend into other sinuses or air spaces, it was never attached in these areas and, meticulous surgical technique allowed us to confirm this intra-operatively. This is supported by the findings of an earlier case

series where pathological samples of secondary sinuses in patients with SNIP were taken and, in each case, were found to be negative for tumour [19].

Utilization of this localizing sign permitted, in all cases, a precise and accurately planned surgical procedure. Although not a primary or secondary outcome in this prospective cohort, in no surgical case was a deviation from the pre-operative surgical plan required. Consequently, no patient required a larger, or second procedure either at the time of initial surgery or at a later date.

DECLARATION

R.K. Bhalla wrote the paper. The patients were under the care of E.D. Wright, who provided editorial advice. R.K. Bhalla accepts full responsibility for the integrity of the article. The authors state no financial interests and no conflicts of interest.

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