Anatomical variations of interest for posterior nasal nerve cryotherapy in the treatment of chronic rhinitis: A radioanatomic study

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RESEARCH NOTE

Anatomical variations of interest for posterior nasal nerve cryotherapy in the treatment of chronic rhinitis: A radioanatomic study

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radiology, rhinitis, sinus anatomy

Key Points

1. An unfavorable insertion of the middle turbinate for cryotherapy was present in 74.2% of cases.
2. Placing cryoprobe 15–30 mm above the nasal floor targets the nerves in 95.8% of cases.
3. Centering the cryoprobe 38 mm behind the inferior turbinate axilla targets the nerves in 94.6% of cases.

1 | INTRODUCTION

Posterior nasal nerve (PNN) cryotherapy aims to treat chronic refractory rhinitis (CRR) using a transmucosal application of a cryogen. PNN comes from the pterygoid canal nerve (formerly called Vidian nerve) and emerges in the nasal fossa through the sphenopalatine foramen (SPF). PNN regulates the secretions of the palatine and nasal mucosa.[1]

PNN cryotherapy requires targeting the SPF area without mucosal dissection. Variations in endoscopic anatomical landmarks[2] might contribute to the relatively high

failure rate (25%–33%).[3–5] Fan et al.[6] suggested a possible link between an unfavorable middle turbinate (MT) position (i.e., in front of the SPF) and the failure of PNN transmucosal procedures for CRR.

However, their study only focused on a retrospective analysis of patients who underwent a PNN procedure. There remains a gap in knowledge regarding the prevalence of unfavorable MT positions in the general population and a lack of well-defined surgical landmarks and measurement criteria.

The objectives of this radioanatomic study were (1) to describe the anatomical variations of the insertion of MT related to the SPF area in the general population and (2) to identify computed tomography (CT) scan landmarks and measurements that can be used pre- and intraoperatively to guide the surgeon in the application of the cryogen, taking into consideration the dimension of the cryoprobe balloon (CB) (15 × 15 mm) of the ClariFix device (Stryker).

2 | METHODS

A database of 157 CT scans from adults, obtained during routine hematological screening and free from sinonasal diseases, was anonymized and used for this study with Institutional Review Board approval (2020PI160). Both sides of CT scans were analyzed by two otolaryngologists, with the following landmarks identified using itk-SNAP software:[7]

- Anterior nasal spine
- Inferior turbinate axilla (ITA) insertion
- Anteromedial point of the tubal orifice
- Posterior nasal spine (PNS), to approximate the level of the nasal floor in the vertical dimension
- SPF
- Mode of insertion of the MT in relation to the SPF: favorable when the MT was inserted behind the SPF, unfavorable in other cases

Anatomical distances between landmarks were calculated using MS Excel Software. Mean distances were described with standard deviation and minimal–maximal values.

The distances were compared to the dimension of the CB to provide information for clinical practice.

3 | RESULTS

The CT scan database included 84 women (53.5%) and 73 men (46.5%), with a mean age of 50.8 ± 14.5[18–83] years.

3.1 | Pattern of insertion of MT in relation to the SPF

Among the 314 CT scan sides analyzed, 233 (74.2%) MT insertions were deemed unfavorable and 81 (25.8%) were favorable. In nine patients (5.7%), the type of MT insertion was different between right and left sides (Supporting Information S1).

3.2 | Anatomical distances for cryogen application

The anatomical distances of interest are summarized in Table 1.

The SPF was located 38.3 ± 4 mm [23.8–52.4] behind the ITA insertion and 22.6 ± 3.6 mm [18.2–29.3] above the PNS on the lateral nasal wall.

Positioning the cryoprobe 15 mm above the nasal floor covers an area extending 15–30 mm upward and theoretically achieves a success rate of 95.9% (n = 301/314) in targeting the SPF in the vertical dimension. Likewise, positioning the center of the CB at 38.3 mm from the ITA in the anteroposterior dimensions results in an application area of 30.8–45.8 mm, with a theoretical success rate of 94.6% (n = 297/314) (Figure 1). Taken together, these conditions yield a theoretical success rate of 90.8% (n = 285/314) (Supporting Information S2).

The mean distance between the SPF and the most anteromedial point of the tubal orifice was 18.2 ± 42.1 mm [9.6; 29.6]. In the studied population, this distance was inferior to the diameter of the CB (15 mm) in 30 sides (9.5%) (Figure 1).

4 | DISCUSSION

PNN cryotherapy is a minimally invasive option for the treatment of CRR. Interindividual anatomical variability can explain part of failure rate. Fan et al.[6] demonstrated a higher prevalence of unfavorable MT insertion in cases of cryotherapy/radiofrequency failure compared to success (90.9% vs. 55%). We found 74.2% of unfavorable MT. In our opinion, MT insertion should be assessed preoperatively, but other factors could be implicated in treatment's failure, such as the symptoms motivating the procedure. Schmale et al.[8] highlighted the importance of preoperative endoscopy and CT scan to optimize cryotherapy indications due to the overlap of symptoms between CRR and chronic rhinosinusitis.

However, CRR diagnosis and management remain based on clinical findings. Thus, the placement of CB

TABLE 1 Descriptive analysis of anatomical distances of interest.

Anatomical distance	Definition	Mean [standard deviation] (mm)	Minimal–maximal (mm)	Clinical significance
Distances in the transverse direction				
Width of the nasal cavity	Between SPF and PNS in the transverse direction (*x* coordinates)	13.3 [2.2]	7.9–19.7	Workspace in the transverse direction
Distances in the horizontal direction				
Anteroposterior endoscopic distance to SPF	Between ITA and SPF (*y* coordinates)	38.3 [4]	23.8–52.5	Length landmarks to target the cryotherapy area
Safety distance from auditory tube	Between SPF and most anteromedial point of the tubal orifice (*xyz* coordinates)	18.2 [2.8]	9.6–29.3	
Distances in the vertical direction				
SPF height level	Between SPF and PNS (*z* coordinates)	22.6 [3.6]	11.2–36.9	Height landmarks to target the cryotherapy area

Abbreviations: ITA, inferior turbinate axilla; PNS, posterior nasal spine; SPF, sphenopalatine foramen.

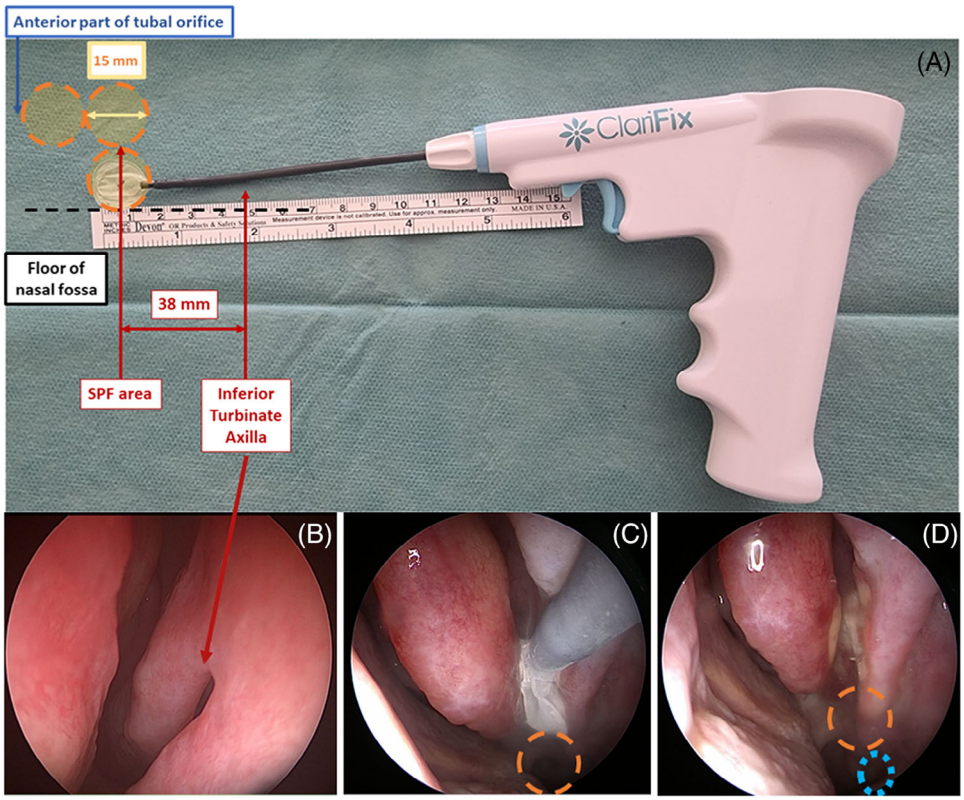

FIGURE 1 (A) Anatomical distances of interest to best target the posterior nasal nerve branches for cryotherapy. (B) Endoscopic view of the left inferior turbinate axilla. (C) Endoscopic view of cryogen application in the left SPF area, in front of the insertion of the middle turbinate. Orange circle: representation of one Clarifix device balloon of distance from the nasal floor. (D) Endoscopic view of the same cryotherapy area after removal of the device. Orange circle: representation of one Clarifix device balloon of distance from the tubal orifice (blue circle). SPF, sphenopalatine foramen.

should rely on direct visual and/or palpatory anatomical landmarks. CB allows freezing a circular area of at least 15 mm. In summary, to seek accurate targeting of the SPF, follow these anatomical guidelines: maintain a 38.3 mm anteroposterior distance between CB center and the ITA center, keep one CB free space (15 mm) safety margin in front of the auditory tube opening, and leave one CB free space above the nasal floor in the vertical axis. These landmarks may offer precise guidance for optimal results (Supporting Information S3).

To reduce the risk of failure, Yen et al.[9] proposed an additional cryotherapy application in the inferior meatus near the nasal floor. According to our data, only 2.5% of patients would benefit from this second application, while exposing them to the risk of greater palatine nerve injury.

5 | CONCLUSION

This radioanatomic study sheds light on variations in the location of the SPF and offers valuable landmarks for cryogen application. However, the external validity of our findings remains limited because the population we studied had no history of CRR and further research is required to build on these findings.

CONFLICT OF INTEREST STATEMENT

Valentin Favier is a consultant for Stryker Corp.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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