Section: Otorhinolaryngology & Head and Neck Surgery

Original Research Article

APPLICATION OF ACOUSTIC DOPPLER SONOGRAM TO ASSESS THE VIABILITY OF NASOSEPTAL FLAP IN DISTINCT SCENARIOS

Received : 22/12/2023
Received in revised form : 10/02/2024
Accepted : 27/02/2024

Keywords:
Acoustic Doppler sonogram, Naso septal flap, Revision CSF leak repair, revision pituitary macro adenoma excision, Choanal atresia repair.

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DOI: 10.47009/jamp.2024.6.1.340

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 1723-1726

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Abstract

Nasoseptal flap also known as Hadad- Bassasteguy flap is recognized for its versatile role in closing the communication between subarachnoid space and nasal cavity in extended endoscopic surgeries. But when the viability of the flap is at stake, as in cases of previous sphenoidotomies, revision pituitary tumour excision, revision CSF leak repair or when the pedicle of the flap cannot be located due to anatomical distortions as in choanal atresia; an acoustic Doppler sonogram comes as a miraculous tool to confirm the patency of the nasoseptal artery which is the feeding vessel of Hadad- Bassasteguy flap. This study is intended to throw light on application of Doppler sonography in surgical scenarios where flap viability has to be confirmed. In addition, the authors would like to commend the nasoseptal flap's role in scenarios other than sealing the dural defect, such as lining a newly created choana in cases of choanal atresia.

INTRODUCTION

Nasoseptal flap is a sturdy and versatile flap in skull base surgeries initially designed by Hadad et al.[1] Its proven efficacy in closing the communication between subarachnoid space and nasal cavity thereby preventing CSF leak makes it a workhorse flap in extended endoscopic approaches. Owing to its wide arc of rotation and plasticity to fashion the size, it can be used for other purposes like lining the newly created choana in patients with choanal atresia. Nasoseptal flap (NSF) / Hadad- Bassasteguy flap (HBF) is pedicled nasal septal mucoperiosteum and mucoperichondrium based on nasoseptal artery which is a branch of posterior septal artery and the terminal branch of internal maxillary artery. The pedicle of this flap crosses the rostrum of the sphenoid and is located between the lower border of sphenoid ostium and the superior part of posterior choana. So the pedicle is likely to be damaged when there is significant widening of sphenoid sinus inferiorly. In choanal atresia where there is an atretic plate preventing visualization of sphenoid ostium and coexisting anatomical variations due to hypoplastic sinuses, the pedicle of the nasoseptal flap cannot be localized with the above said landmarks. In such situations an acoustic Doppler is helpful. The acoustic Doppler probe emits an acoustic wave which will be reflected back from flowing blood deep to the probe. This echoed back wave will be different from the emitted wave resulting in Doppler shift. This will be audible as characteristic pulsatile sound.[2] This article describes 3 cases of revision CSF leak repair, 3 cases of revision pituitary macroadenomas and 2 cases of unilateral choanal atresia where acoustic Doppler was used to ascertain the viability of the nasoseptal flap. A similar study was done by Pinheiro- Neto et al.[3] in 2010 which focussed exclusively on skull base tumours which needed revision surgery and closure of the resultant defect with HBF. This study here focusses on the application of acoustic Doppler sonography for NSF harvesting in revision CSF leak repair and lining neo uni-choana in addition to skull base tumors revision surgeries. Using NSF for lining neo uni-choana is a novel concept wherein the primary author has used modified NSF by reducing the size of the flap to the requirement so that the nasal growth of the child is minimally affected, if any.

MATERIALS AND METHODS

The authors had the opportunity to utilize acoustic Doppler for assessing the nasoseptal flap patency in 3 cases of revision CSF leaks and 3 cases of revision pituitary macroadenomas for sealing the resulting defect; and in 2 cases of unilateral choanal atresia for lining the neo uni-choana. In all the 8 patients,

ISSN (O): 2687-5365; ISSN (P): 2753-6556

informed written consent was obtained either from the patient or from parents if the patient is minor as in cases of choanal atresia. These 8 cases were performed under general anesthesia and intraoperatively viability of naso septal flap was assessed using acoustic Doppler sonography (Bidop ES- 100V3; Hadeco, Inc.2-7-11 Arima, Myame-ku Kawasaki, 216-0003 Japan) (Figure 1). With a 4 mm 0-degree endoscope in the nasal cavity, the tip of the Doppler sonogram probe was placed and moved gently over the area to be examined. In the case of previous sphenoidotomies, the probe is placed and moved between the rostrum of the sphenoid and posterior nasal septum from the inferior border of previous sphenoidotomy to the superior edge of choana. Incisions were marked using monopolar cautery tip / Colorado® microdissection needle tip. Superior incision is made after confirming viability of the pedicle, started from the posterior end of the septum horizontally 1-2 cm below the cephalic end sparing the olfactory epithelium; once anterior end of middle turbinate is reached, the incision can be extended superiorly based on the need of area to be sealed as this part of septum does not have olfactory epithelium. Unlike routine HBF, incision is not extended onto the anterior face of the sphenoid in order to protect the vascular supply of the flap. Inferior incision starts at the superior border of choana corresponding to the floor of the sphenoid sinus and proceeds anteroinferiorly along the floor of the nasal cavity. The two incisions are joined anteriorly, the site of which can be fashioned depending on the area of defect. Incisions are deepened and flap harvested. Whereas in cases of choanal atresia, a 2.7 mm 0-degree endoscope was used because of narrow working space as the patients were in the pediatric age group. In these two cases; due to absence of landmarks, the probe was placed and moved gently from the atretic plate picking up signals and followed anteriorly along the septum. After delineating the pedicle, incisions were made a few millimeters above and below this vascular zone and extended on to the septum. Flap size requirement for lining neo uni-choana in choanal atresia is small, hence the anterior end of the incision was placed at the level of anterior end of middle turbinate in both cases of choanal atresia thereby ensuring minimal hindrance to nasal growth, if any.

RESULTS

Revision CSF leaks

3 cases of revision CSF leak closures utilizing HBF were done after ascertaining viability of nasoseptal artery. The first patient had a persistent CSF leak following endoscopic repair of cribriform leak on the right side which was performed in another centre. CT cisternography revealed a clival leak. Preoperatively, an already performed wide sphenoid sinusotomy was visualized. As mentioned earlier, a sphenoid sinusotomy can endanger the viability of nasoseptal flap. Hence the patency of naso septal artery was ascertained using acoustic Doppler as seen in Figure 2; which revealed its normal patency evidenced by biphasic noise produced when the probe was placed below sphenoidotomy and above the superior border of choana. A right sided HBF was delineated, harvested as discussed above and proceeded with multilayer (fascia lata, fat harvested from thigh, NSF, surgicel, and gelfoam) closure of the defect.

There were two other cases of sphenoid leaks; one in sphenoid planum and another clival leak. In both these cases, previously performed bilateral wide sphenoidotomies were encountered. The leaks were closed with nasoseptal flap from left side for planum leak; and from right side for clival leak after confirming its viability using acoustic Doppler.

Revision pituitary macroadenomas

There were 3 cases of revision pituitary macroadenoma excision where acoustic Doppler sonography was utilized to confirm patency of the artery as these patients had already undergone bilateral sphenoid sinusotomy as part of the previous surgery. Whether HBF was utilized previously could not be established as there were no documentation of method of defect closure. In all these 3 cases the naso septal arteries were patent on both sides (implying other methods of defect closure during the first surgery) and was proceeded with procurement of HBF from right side (Figure 3)

Choanal atresia

There were 2 cases of unilateral choanal atresia. First patient was a 40-day old girl with right side membranous choanal atresia. A 2.7 mm nasal endoscope was used in both these cases as the nasal cavity is smaller in these patients. Flap incisions were made after localising the pedicle of nasoseptal artery using acoustic Doppler sonogram in the manner described in material and methods section. The atretic membrane was excised and bony septum was excised using Kerrison rongeurs taking care not to remove more than one third of posterior bony septum. The uni choana thus created was lined with the HBF flap from the ipsilateral side harvested as in figure 4. Second case was a 14-year-old girl with unilateral nasal discharge since childhood. CT scan of nose revealed right sided bony choanal atresia. The bony atretic plate as well as posterior 3 rd of bony septum was removed using micro drill. In this case, HBF was harvested from both sides. The neo uni-choana was lined on superior and medial border with flap from ipsilateral side while inferior border was lined with flap from contralateral side

3 cases of revision CSF leaks were followed routinely by nasal endoscopy for 6 months with no further episodes of leaks. 3 cases of pituitary macro adenoma excision were also followed up initially with weekly nasal endoscopy; and no cases showed any signs of flap necrosis. An MRI was done 3 months after surgery primarily to look for tumour clearance and integrity of the flap was confirmed by looking for enhancement of the same. They were then followed up routinely with nasal endoscopy for 3 years with no further evidence recurrence or CSF

ISSN (O): 2687-5365; ISSN (P): 2753-6556

leaks. 2 cases of choanal atresia were followed up for 1 year. There were postoperative granulations in both these cases which were managed with topical kenacort injections. The 40-day old child who underwent choanal atresia repair required repeated dilatation of the neo uni-choana for 2 consecutive months; which was done using rigid Hegar serial dilators and now has a patent choana 6 years after surgery. Whereas the 14-year-old girl underwent rigid dilatation 1 month after surgery in a similar way and did not require any further interventions. She is on regular follow up for a period of 3 years.

Figure 1: Acoustic Doppler sonographic equipment. (a) The main unit (b) Probe button and (c) probe tip

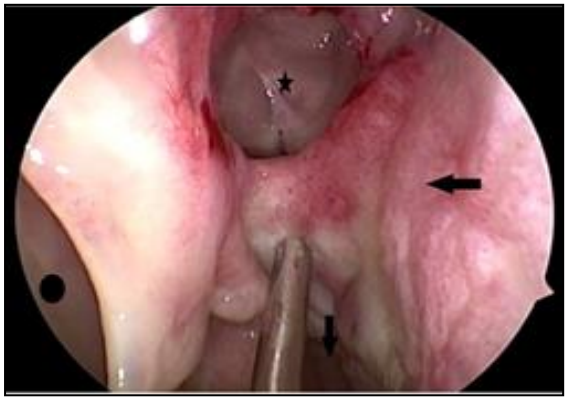

Figure 2: Showing the right nasal cavity where an acoustic Doppler probe placed between the lower end of the sphenoidotomy (star within the sphenoid sinus) and the upper end of choana (marked as down arrow). Left pointing arrow marks the nasal septum and the dot marks maxillary sinus

Figure 3: White arrows showing bilateral sphenoidotomies, acoustic Doppler probe localizing the pedicle of nasoseptal artery and the white star marking the choana

Figure 4: (a) Atretic plate (*) in the right nasal cavity. (b) Marking the incision for rescue flap. (c) Neo uni-choana lined with HBF flap. (d) 2 month post op image showing no restenosis

DISCUSSION

CSF leaks which were repaired had already undergone bilateral sphenoidotomies as part of initial repair; which can potentially damage the pedicle of HBF as the pedicle is located between sphenoid ostium and upper part of choana. Hence harvesting a nasoseptal flap in such cases without confirming the viability of the artery is futile. In order to confirm the same, the tip of Doppler is placed around the junction of sphenoid rostrum and posterior septum and moved between the inferior border of the sphenoidotomy and the superior part of posterior choana. A characteristic pulsatile voice is heard if the artery is patent. This inherent phase shift is detected when there is flowing blood deep to the probe.[3]

In case of choanal atresia, neo uni choana is created by drilling the atretic plate and posterior third of bony septum and is covered by pedicled flap as using stents has increased risk of restenosis and granulations. Various studies show improved results with using vascularised flap. Study by Shamm and Pignatari shows 86% percent success using nasal septal cross over flap.[4] Mladina et al in a case report showed superior results with one year follow up using an anteriorly based mucoperiosteal flap from the opposite side[5]. In the 2 cases of choanal atresia, HBF was used for covering newly created choana.

CONCLUSION

In conclusion, Hadad- Bassasteguy also known as nasoseptal flap is a proven workhorse flap in closing skull base defects following extended endoscopic approaches. It is a robust flap which can be fashioned according to the surgeon's wish owing to its wide arc of rotation, the freedom to adjust the size, and applications in different surgeries. This feature prompted us to utilize this flap in lining the neo-choana. In situations where the viability of the flap is

ISSN (O): 2687-5365; ISSN (P): 2753-6556

in question as in previous bilateral sphenoidotomies or when the anatomical localization of the pedicle of flap is not possible as in choanal atresia, Doppler serves as a wonderful and cost worthy tool to confirm the viability of the nasoseptal flap.

Declarations

Acknowledgements

Nil

Funding: None

Conflict of interest: None declared.

REFERENCES

1. Hadad G, Bassagasteguy L, Carrau RL, et al. A novel reconstructive technique after endoscopic expanded endonasal approaches: vascular pedicle nasoseptal flap. Laryngoscope. 2006 Oct; 116(10):1882-6. doi: 10.1097/01.mlg.0000234933. 37779.e4. PMID: 17003708.
2. Sharipov OI, Kutin MA, Kalinin PL, et al. The use of intraoperative Doppler ultrasound in endoscopic transsphenoidal surgery. Zh Vopr Neirokhir Im N N Burdenko. 2016; 80 (2): 15-20. PMID: 27070254.
3. Pinheiro-Neto CD, Carrau RL, Prevedello DM, et al. Use of acoustic Doppler sonography to ascertain the feasibility of the pedicled nasoseptal flap after prior bilateral sphenoidotomy. Laryngoscope. 2010 Sep; 120(9):1798-801. doi: 10.1002/lary.20996. PMID: 20715092.
4. Stamm AC, Pignatari SS. Nasal septal cross-over flap technique: a choanal atresia micro-endoscopic surgical repair. Am J Rhinol. 2001 Mar-Apr; 15(2):143-8. doi: 10.2500/105065801781543718. PMID: 11345154.
5. Mladina R, Prstacić R, Prstasić R, et al. Septal mucoperiosteal flap for the repair of unilateral choanal atresia. Rhinology. 2009 Sep; 47(3):320-2. doi: 10.4193/Rhin08.080. Erratum in: Rhinology. 2009 Dec; 47(4):338. Prstasić, Ranko [corrected to Prstacić, Ratko]. PMID: 19839259.