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Long Term Patency of Endoscopic Middle Meatal Antrostomy

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Abstract **Original Research Article**

Impairment of normal ventilation and drainage pathways results in various types of sinus pathology. Endoscopic middle meatal antrostomy aims at restoring the ventilation and re-establishing the mucociliary drainage of the maxillary sinus. There has been much debate over the years regarding the optimum size and design of middle meatal antrostomy, its long term patency and relationship with symptomatic improvement of the maxillary sinus pathology. This prospective observational study was conducted in the department of the E.N.T and Head-Neck Surgery of a tertiary care teaching hospital with the objectives of 1) evaluating the long term patency of endoscopic middle meatal antrostomy in maxillary sinus pathology, 2) correlating the size of antrostomy and symptomatic improvement in the post-operative period. Fifty patients undergoing middle meatal antrostomy for isolated inflammatory pathology of the maxillary sinus were studied prospectively for a period of two years. In each patient, the size of antrostomy was recorded by measuring gauze during surgery and in the postoperative period (3^{rd} and 6^{th} month). In the same sitting, the degree of improvement of their symptoms was assessed based on visual analogue scale (VAS). There was statistically significant ($p<0.001$) reduction of both vertical and horizontal lengths of the middle meatal antrostomy (36% and 35% respectively) from the base line (per-operative size). Postoperative symptomatic improvement of maxillary sinus diseases corroborated to the size of the antrostomy at the end of 6 months. This was also statistically significant ($p<0.05$). The antrostomy opening, made at surgery, reduces in size over time. Lesser the reduction of the size of the antrostomy opening, greater the degree of improvements of symptoms.

Keywords: Maxillary sinus, functional endoscopic sinus surgery, middle meatal antrostomy.

INTRODUCTION

The mucocilliary function of the nose and paranasal air sinuses depend on the healthy status of the lining mucosa and proper drainage of the mucus. All major sinuses drain into the nasal cavity through their natural ostia, the pathway of mucocilliary transport being genetically predetermined. Obstruction of these drainage pathways lead to poor ventilation, stagnation of the mucus produced and secondary bacterial infection resulting in inflammatory sinus diseases.

In the maxillary sinus, the secretion drains from the floor, through the natural ostium into the middle meatus. Impairment of normal ventilation and drainage pathways results in various types of sinus pathology like chronic maxillary sinusitis, polyps, mucocele, retention cyst etc. Conventional surgical procedures for inflammatory maxillary sinus diseases were all aimed at clearance of the disease from the sinus. The inferior meatal antrostomy was introduced by Gooch [1] in 1770 whereas Caldwell-Luc [2] popularised his approach in 1893. The Introduction of the endoscope by Hirschmann [1] in 1901 and Hopkins rod system by Harold H. Hopkins [1] in the 1960s revolutionized the medical and surgical management of sinonasal diseases. Later in 1978, pioneering work on the mucocilliary clearance of the nose and paranasal sinuses by Walter Messerklinger [3] led to the concept that most infections of the paranasal sinuses are "rhinogenic". Endoscopic sinus surgery has evolved based on better understanding of this pathophysiology. Functional Endoscopic Sinus Surgery (FESS) is a tissue-sparing, mucosa preserving and minimally invasive surgical technique. Middle meatal antrostomy aims at restoring the ventilation and re-establishing the mucociliary drainage of the maxillary sinus.

There has been much debate over the years regarding the optimum size and design of middle meatal antrostomy, its long term patency and relationship with symptomatic improvement of the maxillary sinus pathology. Draf [4] in 1993 advised to enlarge the ostium to 2×1 cm. Wigand [5] in 1994 commented that 8mm size of the ostium is sufficient for drainage, whereas Setliff [6] and Catalano *et al.*, [7] advocated an uncinectomy alone. Kennedy *et al*., [8] reported 98% patency rate of middle meatal antrostomy and symptomatic improvement as well**.** In 1993, Salam and Cable [9] observed 89% patency rate of middle meatal antrostomy and its significant relationship with symptom improvement. Busaba *et al*., [10] in 2002 reported resolution of symptoms and a patent antrostomy in long term follow-up in all cases of maxillary sinus mucocele. Albu and Tomescu [11] in 2007, on the other hand, suggested that the size of the middle meatal antrostomy has no influence on the outcome of endonasal surgery. The objectives of the present study are:

1. To evaluate the long term patency of the middle meatal antrostomy in terms of its size during post-operative follow-up period.
2. To find out the relationship between the size of middle meatal antrostomy and improvement of the symptoms of maxillary sinus pathology.

MATERIALS AND METHODS

The study was undertaken in the department of E.N.T and Head-Neck Surgery of a tertiary care teaching hospital, Vivekananda Institute of Medical Sciences, Kolkata, India, over a period of two years (October 2008 to September 2010).The study design was a prospective observational one.

Inclusion Criteria: Adult patients suffering from isolated inflammatory maxillary sinus disease were included in the study.

Exclusion Criteria: Patients below 18 years of age, multiple sinus involvement, suspected malignancy and revision cases were excluded from the study.

The study was approved by the Institutional Review Board (Institute Ethics Committee of Ramakrishna Mission Seva Pratisthan). 50 consecutive patients were selected as per the inclusion and exclusion criteria. Informed and written consents were obtained from every patient. A detailed history was recorded in a customized proforma. Nasal obstruction, nasal discharge and headache were the chief presenting symptoms. Anterior and posterior rhinoscopy as well as diagnostic nasoendoscopy was performed in all the cases. Radiological assessment of the nose and paranasal sinuses was made by computed tomographic (CT) scan in a 16 slice scanner (coronal and axial sections) before surgery. Contrast was used wherever necessary.

All patients underwent endoscopic middle meatal antrostomy under general anesthesia. A senior surgeon of the unit was the operating surgeon in all the cases. Initial nasoendoscopic examination displayed different types of abnormalities indicating maxillary sinus diseases like, retained pus or mucopus, edematous or polypoidal mucosa, polypi or cysts etc. Thereafter, local infiltration was made with 1:80,000 adrenaline in saline. Any obstructive pathology in the middle meatal area was first removed, followed by infundibulotomy, by removal of the uncinate process. The natural ostium of the maxillary sinus was then identified and widened to create the antrostomy. Any accessory ostia in the region of anterior or posterior fontanelle were joined with the natural ostium. Care was taken not to enlarge the natural ostium circumferentially to avoid the risk of stenosis of the antrostomy. The interior of the maxillary sinus was inspected using 4mm 45º and 70º rigid endoscopes and appropriate removal of the disease from the sinus was undertaken. Finally, both vertical and horizontal length of the antrostomy was measured by means of a specially designed distance measuring gauze (Figure 1 and 2).

Fig-1: Per operative measurement of horizontal length of antrostomy by gauze

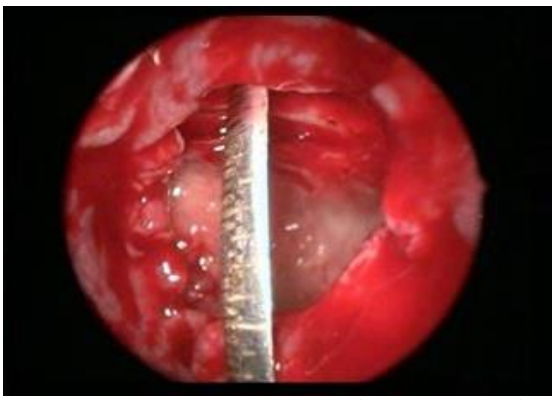

Fig-2: Per operative measurement of vertical length of antrostomy by gauze

Merocele nasal pack was used for packing the nose which was usually removed after 24 hours of

surgery. Patients were discharged on 2nd postoperative day with the advice of using normal saline nasal spray and douching regularly. All patients were followed up at the end of 3weeks, 6 weeks, 3 months and 6 months after operation.

At the end of 3 and 6 months, patients were advised to complete a questionnaire for assessing the degree of improvements of their three principal symptoms namely, nasal obstruction, nasal discharge and headache. They were asked to rate this on a 4 point visual analogue scale (VAS), where 0 stands for relieved from symptoms, 1 for improved, 2 for unchanged and 3 for worsened. Subsequently the operated cavities were evaluated endoscopically. Both the vertical and horizontal lengths of the middle meatal antrostomy (MMA) were measured with the help of the same measuring gauze which was used peroperatively.

Statistical analysis of the measurement of the size (both vertical and horizontal) of the middle meatal antrostomy was performed using paired t test. The relationship between the size (both vertical and horizontal separately) of the antrostomy and the degree of improvement in each of the symptoms was evaluated using the ANOVA test. The level of significance (alpha) was taken at 5% i.e. in cases of any p value <0.05 the results were taken to be statistically significant.

RESULTS

The total number of patients included in this study was 50. There were 32 (64%) males and 18 (36%) females with a male: female ratio of 16:9. The mean age of the patients was 34.94 years, ranging from 18 to 65 years. Nasal obstruction and nasal discharge were the common presenting symptoms in all the patients whereas 25(50%) subjects complained of associated headache. Other symptoms such as facial pain, hyposmia and epistaxis were only occasionally complained of and thus were not taken into consideration. 46 patients had unilateral maxillary sinus pathology out of which 15(33%) had chronic maxillary sinusitis, 11(24%) had antral cyst, 13(28%) presented with antrochoanal (AC) polyp and the rest 7(15%) had fungal balls. Bilateral maxillary sinuses were involved in 4 patients out of which 3(75%) had chronic maxillary sinusitis and 1(25%) had an antral cyst.

Six months following surgery, symptomatic improvement (either relieved or improved) was 86% for both nasal obstruction and nasal discharge and 76% for headache.

The smallest (minimum) vertical measurement of MMA at surgery was 6mm and the largest (maximum) was 15 mm (Mean 10.64mm) (Table-1). Similarly the smallest (minimum) horizontal measurement of MMA peroperatively was 8mm, largest being 20mm (Mean 14.84mm) (Table-2).

At the end of 6 months the mean vertical and horizontal sizes of MMA were recorded to be 6.76 mm and 9.60 mm respectively (Table 1 and 2). It was observed that both the vertical as well as horizontal measurements of MMA reduced in size by 36% and 35% respectively from the base line (per-operative size) and were found out to be statistically significant (p<0.001). Complete closure of the antrostomy was not documented in any of the patients.

Table-1: Change in Vertical Measurement of MMA over time

	Vertical Measurement (mm)			***p* Value**	
MMA Measurement	**Intra operative**	**After 3 Months**	**After 6 Months**	**Between intra Operative & After 3 Months**	**Between intra Operative & After 6 Months**
Minimum	6	2	2		
Maximum	15	12	12		
Mean	10.64	6.82	6.76	<0.001	<0.001
Std. Deviation	2.601	2.292	2.273		

Table-2: Change in Horizontal Measurement of MMA over time

	Horizontal Measurement (mm)			***p* Value**	
MMA Measurement	**Intra Operative**	**After 3 Months**	**After 6 Months**	**Between Intra Operative & After 3 Months**	**Between Intra Operative & After 6 Months**
Minimum	8	3	3		
Maximum	20	15	15		
Mean	14.84	9.68	9.60	<0.001	<0.001
Std. Deviation	3.940	3.292	3.320		

Both the vertical and horizontal measurements of MMA were corroborated separately with the degree of improvement of each of the symptoms of maxillary sinus pathology at 3 months and 6 months after surgery. Lesser the reduction of the size of the antrostomy (both vertical and horizontal), better the degree of improvement of all three symptoms, e.g., nasal obstruction, nasal discharge and headache. The relationship was statistically significant (p<0.05) in all the patients at the end of 3rd month and 6th month.

Table-3 shows the relationship between the degree of improvement of nasal obstruction and the size of the antrostomy 3 months after surgery. The above table suggests that patients who maintained large antrostomies had their nasal obstruction either relieved or improved. On the other hand, the symptom remained unchanged in those whose antrostomy decreased in size postoperatively. Similar association was recorded for the other two symptoms, namely nasal discharge and headache on 3rd and 6th month postoperatively (Table 4-8).

This relationship between the size of the postoperative antrostomy and symptomatic relief of patients (nasal obstruction, nasal discharge & headache) was statistically significant (p<0.05).

Table-3: Relationship between postoperative nasal obstruction and antrostomy size

Antrostomy size (mm)	Nasal Obstruction After 3 Months						
	Relieved (n=10)		Improved (n=33)		Unchanged (n=7)		
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	*P* Value
Vertical	7.40	2.32	7.30	1.88	3.71	1.70	<0.001
Horizontal	10.70	3.50	10.42	2.46	4.71	2.06	<0.001

Table-4: Relationship between postoperative nasal discharge and antrostomy size

Antrostomy size (mm)	Nasal Discharge After 3 Months						
	Relieved (n=11)		Improved (n=32)		Unchanged (n=7)		
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	*P* Value
Vertical	7.27	2.24	7.34	1.89	3.71	1.70	<0.001
Horizontal	10.64	3.32	10.44	2.50	4.71	2.06	<0.001

Table-5: Relationship between postoperative headache and antrostomy size

Antrostomy size (mm)	Headache After 3 Months						
	Relieved (n=4)		Improved (n=15)		Unchanged (n=6)		
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	*P* Value
Vertical	8.75	2.99	7.67	2.02	3.67	1.51	0.001
Horizontal	12.50	1.91	10.13	1.96	5.00	2.61	<0.001

Table-6: Relationship between postoperative nasal obstruction and antrostomy size

Antrostomy size (mm)	Nasal Obstruction After 6 Months						
	Relieved (n=9)		Improved (n=34)		Unchanged (n=7)		
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	*P* Value
Vertical	7.11	2.26	7.32	1.85	3.57	1.62	<0.001
Horizontal	10.33	3.50	10.47	2.44	4.43	2.15	<0.001

Table-7: Relationship between postoperative nasal discharge and antrostomy size

Antrostomy size (mm)	Nasal Discharge After 6 Months						
	Relieved (n=10)		Improved (n=33)		Unchanged (n=7)		
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	*P* Value
Vertical	7.00	2.16	7.36	1.87	3.57	1.62	<0.001
Horizontal	10.50	3.34	10.42	2.46	4.43	2.15	<0.001

Table-8: Relationship between postoperative headache and antrostomy size

Antrostomy size (mm)	Headache After 6 Months						
	Relieved (n=5)		Improved (n=14)		Unchanged (n=6)		
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	*P* Value
Vertical	8.20	2.49	7.64	2.10	3.50	1.38	0.001
Horizontal	11.60	1.67	10.14	2.03	4.67	2.73	<0.001

DISCUSSION

Endoscopic sinus surgery is a tissue-sparing, mucosa preserving and minimally invasive surgical technique. Middle meatal antrostomy is an important step of the endoscopic sinus surgery which is easily performed through the membranous fontanelle [12]; Straatmann and Buiter, 1981 [13] and has less tendency for closure [14] and Kennedy *et al*., [8]. This antrostomy is the dependent site for drainage of the antrum in the supine position [12]. Moreover, the mucociliary clearance of the maxillary sinus is directed towards the natural ostium [15]. For all these reasons middle meatal antrostomy is now considered the treatment of choice for treating maxillary sinus diseases.

Patients with maxillary sinus diseases may present with various symptoms but nasal obstruction, nasal discharge and headache are most frequently encountered and have been considered as chief presenting symptoms in our study. All 50 patients with isolated maxillary sinus diseases underwent MMA and were followed up for 6 months after surgery. Both the vertical and horizontal size of MMA was measured at the end of 3 months and 6 months after surgery. Per-operatively, the mean vertical and horizontal size of MMA was 10.64mm and 14.84mm respectively. After 6 months of follow up visit, they reduced to 6.76mm and 9.60 mm respectively. We found that both the vertical as well as horizontal size of MMA reduced in size (36% and 35% respectively) from the base line (per-operative size) which were statistically significant (p<0.001). But none of the antrostomies were found to be completely closed.

This finding is corroborative with the findings by Salam and Cable [9] where 89% antrostomies were patent with the mean size of 5mm. Our results are also in line with the findings by Kamel [16] where 84% antrostomies were found to have the mean size of 8mm, as well as the findings by Davis *et al*., [17] where the overall patency rate of antrostomies was 94.08%. Our results are at par with the results by Zhou *et al*., [18] and Busaba *et al*., [10], 2002 where they found a patent antrostomy in long term follow up in all cases of maxillary sinus diseases. Albu and Tomescu, 2004 [11] recorded 2mm as the minimum diameter of the ostium. In the present series, 2mm and 3mm were the minimum vertical and horizontal length of MMA respectively 6 months after surgery. Furthermore, our study looked at the pattern of reduction of MMA over time. It was noted that maximum reduction of size of MMA tends to occur within first 3 months of surgery.

In our study, subjective improvement was significant and maintained after surgery. At the end of 6 months of follow up, improvement (either relieved or improved) was 86% for nasal obstruction and nasal discharge and 76% for headache. This result is very much similar to the result of Gaskins [19] where he reported improvement of nasal obstruction in 94% and headache in 83% of patients.

We also evaluated the relationship between the size of MMA and degree of improvement in each of the symptoms of maxillary sinus pathology. This relationship was statistically highly significant (p<0.001) at the end of 3rd month and 6th month after surgery. In patients having large antrostomies, almost all the symptoms were either relieved or improved, whereas most of the symptoms remained unchanged in patients having small sized antrostomy. Our study is corroborative with the study by Salam and Cable [9] and Busaba *et al*., [10] where they observed a significant relationship between the degree of patency of antrostomy and the degree of improvement in each of the symptoms of chronic maxillary sinusitis and in all cases of maxillary sinus mucocele respectively. Kennedy *et a*l., [8]; Stammberger and Posawetz [20] have considered that 3mm diameter is the minimum patency required for a maxillary sinus ostium to function sufficiently. On the contrary, our data suggest that minimum diameter of 5mm or above needs to be maintained in order to achieve symptomatic relief and optimum function.

While most of the publications have documented a definite correlation between the size of the antrostomy and the degree of symptom improvements in the postoperative period, Albu and Tomescu in 2004 [11] have opined in a different way. They conducted a prospective randomized study encompassing 133 patients with chronic maxillary sinusitis who underwent middle meatal antrostomies. They failed to find out any statistically significant correlation between the degree of improvements of symptoms and the postoperative size of the antrostomy. Our results do not corroborate with the results of Albu and Tomescu.

CONCLUSION

The middle meatal antrostomy opening (MMA), created during endoscopic sinus surgery, reduces in size with passage of time. Furthermore, maximum reduction of size of MMA tends to occur within first 3 months of surgery. There is also a definite correlation between the maintained size (both vertical and horizontal) of MMA and the degree of improvement of each symptom in the long term. Lesser the reduction of the size of the antrostomy opening, greater the degree of improvement of symptoms. Moreover, minimum diameter of 5mm or above needs to be maintained for relief of symptoms and optimum function.

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