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Research Article

Extent of surgery in chronic rhinosinusitis: primarily focused on nasal polyposis

Abstract

Background: The prevalence of chronic rhinosinusitis with nasal polyps (CRSwNP) is estimated at around 4% in general population. The population-based studies using rhinoscopy have demonstrated the prevalence of nasal polyposis, with values ranging from 0.5 to 2.7%. If the symptoms and reduction in the quality of life persists despite adequate conservative therapy, then such patients are indicated for surgical treatment. This review aims to summarize existing literature and discuss the issue of the extent of the surgery in polyp disease.

Methods and Results: Forty-five relevant articles were identified using a multi-step search of the web-based PubMed database from the National Library of Medicine. These included articles published between January 1985 and December 2016 and separated into three categories according to surgical intervention: simple polypectomy, complete ESS vs. targeted procedures and extended procedures. The last category was further subdivided into 5 subgroups and discussed separately; namely: middle turbinate resection, radical ethmoidectomy (nasalisation), extended endonasal maxillary antrostomy, approaches through anterior wall of maxillary sinus and Draf 3 frontal sinusotomy.

Conclusion: Due to the considerable lack of randomised controlled trials for the surgical treatment, the optimal extent of surgery in CRSwNP has not been established yet. Although there are a number of studies dealing with surgical treatment of CRSwNP, and some data suggests that in cases of severe, diffuse or recurrent polypoid disease, better outcomes can be achieved by more extensive surgical approaches, unfortunately a great heterogeneity still exists amongst patients' characteristics, design of studies and disease severity thus making collection of high level of evidence still challenging.

Introduction

Along with chronic rhinosinusitis without nasal polyps is chronic rhinosinusitis with nasal polyps (CRSwNP) one of two basic phenotypes of chronic rhinosinusitis (CRS). The prevalence of CRSwNP is estimated at around 4% in general population [1]. The population-based studies using rhinoscopy have demonstrated the prevalence of nasal polyposis, with values ranging from 0.5 to 2.7% [2,3].

Although currently we observe efforts to individualize treatment for CRS according to its different endotypes, it can be stated that medical treatment is still based on steroids (long-term treatment with local steroids and short courses of oral steroids). If the symptoms and reduction in the quality of life persists despite adequate conservative treatment, then such patients are indicated for surgical treatment. The current standard of surgical treatment is represented by endoscopic sinus surgery (ESS). According to the traditional concept of ESS,

the extent of surgery depends on the extent of the inflammatory disease with a goal to restore ventilation and drainage of the sinuses with a simultaneous effort to spare healthy uninvolved mucosa. However, it is clear that CRSwNP is rather a diffuse mucosal disease and not a disease that primarily affects sinus ostia. From this perspective, ESS does not only reestablish mucociliary transport, but also has a positive effect on topical delivery of medication and decreases the overall inflammatory load. Despite medical and surgical treatment, the rate of polyp recurrence after surgery has been reported to be as high as 60% [4,5].

This review aims to summarize existing literature and discuss the issue of the extent of surgery in CRSwNP.

Methods and Results

A multi-step search of the web-based PubMed database from the National Library of Medicine was performed with the limits set to include article published between January 1985 and

December 2016. Search terms used were, chronic rhinosinusitis with nasal polyps, nasal polyposis, endoscopic surgery, extent of the surgery, surgical outcomes. Abstracts and full texts were reviewed. Articles irrelevant to the topic and written in another language than English were excluded. Relevant papers, authors and cited references were cross-checked using Journal/Author Name Estimator (JANE).

After the 45-relevant articles were identified, they were separated into three groups according to their topics: (i) simple polypectomy, (ii) complete ESS vs. targeted procedure and (iii) extended procedures. The last category was further divided into 5 subgroups and discussed separately; namely: middle turbinate resection, radical ethmoidectomy (nasalisation), extended endonasal maxillary antrostomy, approaches through anterior wall of maxillary sinus and Draf 3 frontal sinusotomy.

Polypectomy

Although simple polypectomy leads to a temporary improvement of symptoms of the disease, it is associated with high risk of recurrence, especially in patients with severe, diffuse polyposis [4,6].

The study conducted by de Mayne et al., retrospectively compared functional and anatomical scores, complications and rates of revision surgery for symptomatic polyp recurrence in 77 patients who underwent ethmoidectomy and 50 patients who underwent only endoscopic shaver- polypectomy. Although the congestion, pain and anatomical score were improved to a significantly greater extent in the ethmoidectomy group, revision surgery rate was comparable (9.1% vs. 8%) with fewer local complications in the polypectomy group [7].

Sharma et al., in 2014 made an attempt to review the available literature to assess the effectiveness of simple polyp surgery versus more extensive surgical procedure in nasal polyps [8]. They identified only six controlled trials (five randomised) which met some but not all of the inclusion criteria: two of the studies compared using standard instruments versus microdebriders in endoscopic surgery [9,10], one study compared large antrostomy versus undisturbed maxillary ostium [11]. The trial of Venkatachalam from 1998 evaluated endoscopic and conventional surgical procedures in nasal polyposis [12], Jankowski et al., published a comparison of nasalisation (see also the section Extended procedures) and functional ethmoidectomy [5] and Kuehnemund et al., in a prospective, randomized study on 65 CRS patients compared extended versus limited approach [13]. Based on these poor results, the authors of the review had to exclude all six mentioned studies from the review and conclude that there is no available evidence to support either polypectomy or more extensive surgical procedure as a superior surgical modality in the CRSwNP treatment [8].

In Summary, randomised controlled trial on homogenous CRSwNP-patients group is desirable to determine whether more extensive sinus procedure offers any advantage over polypectomy alone. Simple polypectomy could be considered, as it is less time consuming, can be performed with limited equipment, reduces costs and has lower rate of complications.

Complete ESS vs. limited (targeted) procedure

A prospective randomized study from 2002 showed no significant difference in the results of surgical treatment in 65 patients who underwent either limited ESS procedure (middle meatal antrostomy, uncinectomy and bulla removal) or complete ESS (clearing of all sinuses). Evaluated outcomes in this study were endoscopy, symptoms assessment and saccharin transport time. The authors concluded that limited conservative procedure is sufficient in most patients with CRS. However, the study included patients with and without nasal polyps [13].

A retrospective study done by Masterson et al., compared 149 patients with nasal polyposis (both primary and revision cases) in which extensive ESS was performed (defined as polypectomy, maxillary antrostomy, complete ethmoidectomy and exploration of frontal sinus) with patients included in a National Comparative Audit [14]. The later had undergone procedure limited to anterior ethmoid cells. The authors demonstrated lower rates of revisions in patients with extensive surgery, 36 months after the primary procedure 4,0 % vs 12,3 %; $p=0,006$ [15].

In a recent multi-center prospective observational cohort study, 311 patients with CRS who failed medical therapy were enrolled. The extent of the surgery was determined by the surgeon either as complete surgery (all sinuses were opened; 147 patients) or targeted (any procedure less complete; 164 patients). Despite the fact that in the complete surgery group, there was a significantly higher prevalence of asthma, aspirin sensitivity, nasal polyps and greater burden of disease pre-operatively (quality of life measured by SNOT-22 and smell evaluated by Th Brief Smell Identification Test), these patients received a greater benefit compared to those undergoing a targeted approach [16].

In summary, two prospective studies (one randomised) with conflicting results are available, but both the studies included patients with CRS with and without polyps.

Extended procedures

Middle turbinate resection: There are still conflicting views on the middle turbinate resection (MTR) in CRSwNP patients. The authors who are not in favour of MTR warn against the risk of atrophic rhinitis, CSF leak, loss of surgery landmarks, postoperative bleeding, impaired sense of smell and the increased risk of iatrogenic frontal sinusitis. Conversely, supporters of MTR argue, a better intraoperative and postoperative visualization, improved sinus ventilation and better availability of topically administered medications [17-20]. There are two recent cadaveric studies confirming better distributions of topical drugs after partial and complete middle turbinate resection [21,22].

In a study on 200 patients, Davis et al., documented that MTR is the most important variable in prediction of middle meatal antrostomy patency [23]. Whilst one study considers lateralized stump of middle turbinate as a risk factor of iatrogenic frontal sinusitis [24], another trial does not support

this fact [25]. Another study even considers partial MTR as one of the important factors preventing postoperative frontal sinusitis [26]. Miller et al., compared 139 patients with unilateral MTR and 89 patients with bilateral MTR retrospectively and concluded that MTR is not a significant risk factor for major postoperative bleeding [27].

Marchioni performed a prospective study on patients that underwent ESS for severe nasal polyposis and compared the outcomes of those with (22 patients) and without (34 patients) MTR. In this study, the patients who had middle turbinate preserved during the procedure, were 4 times more likely to develop recurrence of the polyps than the patients with MTR [28]. Similarly Wu et al., demonstrated in a retrospective study, the beneficial effect of MTR significantly delays the interval until the revision procedure is required [29].

Soler et al., performed a multi-institutional prospective observational study comparing 47 subjects in MTR group and 195 patients with MT preservation. In this study, patients had diagnosis of CRS with or without NP based on Rhinosinusitis Task Force criteria [30]. The study found no difference in QoL improvement after surgery, however patients after MTR showed greater improvement in postoperative nasal endoscopy and smell tests; the authors concluded that the decision to preserve or resect middle turbinate can be left to the decision of the surgeon with little or no negative consequences [31].

Byun et al., prospectively evaluated baseline disease burden and surgical outcomes between MTR group and middle turbinate preservation in CRSwNP patients. In this study, patients with MTR had greater disease burden (extent of polyposis, Lund-Mackay score and poorer symptom score) preoperatively than the preservation group. Accordingly, the authors concluded this may be a reason for the poorer surgical outcomes in MTR group. However the subjective outcomes (SNOT-20 and visual analogue scale) did not differ significantly between the groups [32].

To summarise, there are several prospective studies on this topic. One study with smaller sample of patients, (exclusively suffering from severe polyposis), proved statistically significantly difference in proportion and time of polyps recurrence in favor of MTR group [28]. The other prospective study (but included both patients with CRSwNP and CRSsNP) showed greater improvements in nasal endoscopy and smell in MTR group [31]. The third study proved better objective outcomes in the preservation group and successful comparable subjective outcomes regardless of resection or preservation [32].

Radical ethmoidectomy (nasalisation): In the nasalisation concept, the goal of the procedure is to transform former ethmoid labyrinth in to a unique cavity, widely opening to the nose and well communicated with frontal, sphenoid and maxillary sinus. The key points of this surgery are large sphenoidotomy and middle meatal antrostomy, MTR, removal of all bony ethmoidal lamellae and ethmoidal mucosa as much as possible (but without hazards) and centripetal dissection towards the fronto-nasal communication [33,34]. The "classical concept of EES" (i.e. restoration, ventilation and

re-establishment of mucociliary transport depending on the disease extent), is in the nasalisation procedure replaced by an effort to achieve better distribution of topical steroids and as well as to reduce eosinophil reservoir in ethmoidal mucosa [35]. Jankowski et al., used functional symptom questionnaire for patients with diffuse polyposis and demonstrated significantly better functional results in patients after nasalisation compared with those after functional ethmoidectomy (follow-up 18-36 months) [34]. These functional results were confirmed by another study with a 5-year follow-up. Moreover, in this study, patients after radical ethmoidectomy achieved better endoscopic and CT scores. The recurrence rate was also significantly better in the nasalisation group compared to the ethmoidectomy group (22.7 % vs. 58 %) [5]. Another study (prospective comparison of systemic steroid treatment and nasalisation) of the same group confirmed that radical ethmoidectomy with MTR does not alter the possibility to restore the sense of smell postoperatively [36].

Although these are retrospective studies, it can be suggested, that even long-term outcomes in patients with diffuse nasal polyposis may be improved after more extensive procedure.

Extended endonasal maxillary antrostomy: At this time, despite much debate, the optimal size of maxillary antrostomy remains unclear [37]. The main concern against large antrostomy is its association with excessive air exposure and reduced mucociliary clearance. On the other hand, small antrostomy may be connected with postoperative edema, persistent obstruction and scar formation [37,38]. It has been stated that so called standard antrostomy is more than 90 % effective in managing chronic maxillary sinusitis [39]. Despite high efficiency rates of this procedure, some patients with CRSwNP fail standard antrostomy and need more radical revision procedures.

In the randomised controlled trial, the patency rate of drainage lumen between large middle meatal antrostomy and undisturbed maxillary ostium in patients with nasal polyposis was compared. Sixty patients with similar degree of nasal polyposis were enrolled in the study. On one side large antrostomy was performed, whereas on the other side the undisturbed maxillary ostium served as a control. Although 60 % of cases had an adequate drainage at the final evaluation, only in early phase of evaluation, large antrostomy significantly showed better patency than undisturbed ostium [11].

The modified endoscopic medial maxillectomy (MEMM) is the generally accepted approach for sinonasal tumors, however it's role in inflammatory disease, specifically in polypoid disease is less well defined [40]. It is supposed that communication between nasal cavity and maxillary sinus at the level of floor of the nose may enhance mucociliary clearance (which in case of maxillary sinus must works against gravity). In the cadaveric study, medial maxillectomy has also shown an increased distribution of topical solutions in comparison with standard ESS [41].

Depending on the pathology and extent of the disease, various modifications of the MEMM can be performed. These

may be preserving anterior aspect of the medial maxillary wall, nasolacrimal duct or even inferior turbinate (or its part) if possible [42].

Woodworth et al., retrospectively reviewed 19 patients who underwent 24 MEMM for recalcitrant maxillary sinusitis and who failed prior surgery with an average follow-up of 19.5 months. In this cohort, only one patient still suffered from persistent hyperplastic sinusitis requiring medical treatment [43].

In another retrospective study, Cho and Hwang evaluated efficiency of 42 procedures called Endoscopic maxillary mega-antrostomy (EMMA) in 28 patients with recalcitrant maxillary sinusitis with 11 months of average follow-up. This procedure involves extending the antrostomy through the posterior half of the inferior turbinate down to the floor of the nasal cavity. In this study 74 % of patient reported complete resolution of symptoms while 26 % reported partial improvement and revision rate was 0% [44]. These results were confirmed by a later study by the same group, in which sustained improvement of symptoms was demonstrated with a mean follow-up period of 6.9 years. Moreover, the original cohort of 28 patients was expanded to another 94 patients using validated outcome measures (SNOT-22 quality of life questionnaire and Lund-Kennedy endoscopic score) [45].

Wang et al., published a retrospective review of 46 patients (total of 61 procedures) who underwent MEMM for recalcitrant maxillary CRS. In this study, complete resolution of disease was achieved in 80% of patients (37/46) and no revision surgery was required [46].

To conclude, based on the above mentioned studies, it seems that extended maxillary approaches are effective and safe treatment options for the management of recalcitrant maxillary inflammatory disease, especially when previous surgery failed. But it is necessary to mention that compositions of the patient cohorts are inhomogenous, that is, including CRS patients with and without polyps. One randomised controlled study proved that large antrostomy had a better patency only in early postoperative phase compared to undisturbed maxillary ostium [11].

Approaches through anterior wall of maxillary sinus: Several studies deal with the assessment of the effect of canine fossa puncture or trephination (CFP, CFT) in surgical treatment of CRSwNP.

A prospective randomized study comparing the results of surgical treatment of CRSwNP (postoperative symptom score and CT scan) in patients who underwent either CFP or clearance of the maxillary sinus through the middle meatus antrostomy (MMA), found no benefit of CFP over MMA [47].

In contrast, studies from 2005 and 2012, comparing MMA and CFP (1 of these studies is prospective), point out the fact, that the CFP allows complete clearance of the maxillary sinus which leads to better control of symptoms, endoscopic finding and reduces the need for revision surgery [48,49].

Also a retrospective study done by Sieberling et al., evaluated 97 patients who underwent CFP as part of ESS and concluded that CFT allows complete clearance of severely diseased maxillary sinus and decreases recurrence rates in patients with CRSwNP [50].

In conclusion, one prospective randomized study conducted on homogenous group of patients with CRSwNP, did not demonstrate any advantage of CFP over middle meatal antrostomy. But the size of both groups were relatively small in this study (11 versus 13 patients) [47]. In contrast, one prospective study on CRSwNP patients, proved better postoperative endoscopic outcomes and decrease in the need for revision surgery in CFT group [49].

Draf 3 frontal sinusotomy: One of the indications of Draf 3 (D3) sinusotomy (or endoscopic modified Lothrop procedure) is polyp recurrence in subgroup of patients with refractory, aggressive polyp disease, especially in patients who has failed less radical frontal sinus surgery.

Bassiouni et al., retrospectively compared on 338 consecutive operations for CRSwNP the effect of frontal sinus surgery (Draf 3 vs. Draf 2a). In the median follow-up of 29 months the overall revision rate was 18%, with 37 % revision rate in D 2a group versus 7 % in Draf 3 group ($P < .001$). The Draf 3 procedure was a significant factor in reducing recurrence of the polyps, especially in asthma and aspirin intolerant patients [51]. Another study by the same group reviewed long term results of D3 procedure on 229 patients (average follow-up was 45 months). In this study, patients were indicated for D3, only when standard ESS failed (average number of previous ESS procedures was 3.8) and there was recurrence of polyp disease along with persistence of symptoms despite adequate medical therapy. The D3 was successful in 95 % (217/229). In this study, more than 50% of all patients (135/229) were diagnosed with CRSwNP [52].

The most recent study was focused on subgroup of patients with nasal polyps and aspirin-exacerbated respiratory disease (AERD). The failure rates of standard ESS in these patients is reported to be as high as 90 %. In this study data from 31 AERD patients, who underwent sphenoidectomy, maxillary antrostomy and D 3 procedure, was collected prospectively with an average follow-up of 36 months. Polyp recurrence was noted in 18 patients (58 %). Seven (22.5 %) patients required revision D3 surgery. The authors concluded that this type of procedure is successful in a significant majority in AERD and CRSwNP patients [53].

Therefore to summarize, recent studies suggest, that, more aggressive frontal surgery appears promising, especially in revision cases for patients with CRSwNP associated with comorbidities like asthma and AERD.

Conclusion

There is a considerable lack of randomised controlled trials for the surgical treatment and the optimal extent of surgery in CRSwNP has not been established yet. Although there are a number of studies dealing with surgical treatment of CRSwNP,

a great heterogeneity exists amongst patients' characteristics, design of studies and disease severity thus making collection of high level of evidence still challenging. But there are some data suggesting that in case of severe, diffuse or recurrent polypoid disease, better outcomes can be achieved by more extensive surgical approach.

In our attempt in doing this review, we find that a lot of issues have not been addressed. Therefore, further research in this area should be focused on several aspects such as (i) what is the optimal extent of the procedure in primary surgery cases? (ii) What procedure to choose if the revision is necessary? And finally (iii) what is the role of disease severity and comorbidities associated with nasal polyposis (especially asthma and AERD) in this decision making process?

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