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LITERATURE REVIEW

Nasal packing in endonasal surgery - a literature review

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ABSTRACT

Nasal packing is currently used as a step of the nasal surgery in order to prevent hemorrhage and to ensure a normal wound healing process. The range of materials used for this purpose is wide, including both removable and absorbable materials. Because currently there is no standardization in this matter, the choice is in the surgeon's hand, according to his abilities, beliefs, or technical possibilities. This article reviews the literature on the use of both absorbable and removable materials used for hemostasis after nasal surgery in the last decades, trying to reveal the advantages and also the weak points for both methods.
KEYWORDS: nasal packing, endoscopic sinus surgery, epistaxis, adhesion, wound healing process

INTRODUCTION

Hemostasis, during and after nasal surgery, still raise a lot of debates concerning the most suitable method regarding the efficacy, patient comfort, risks and costs. Each endonasal surgical procedure such as septoplasty, rhinoplasty, as well as endoscopic sinus surgery, especially when combined with turbinectomy and/or submucous resection of the septum, may produce bleeding and/or postoperative hematoma requiring postoperative hemostatic measures[1].

All rhinologic surgeons have the common goal of obtaining excellent hemostasis and good postoperative healing that avoids adhesion formation, together with infection prevention. Even if, the goal is common, how this can be achieved is still debatable.

The most frequent attitude regarding nasal hemostasis during and after nasal surgery is represented by choosing one of the following methods:

- removable nasal packing;
- absorbable nasal packing;
- no packing at all.

Because presently there is no standardization in this matter, the choice is in the surgeon's hand, according to his abilities, beliefs, or technical possibilities.

Besides of controlling ongoing bleeding after nasal surgeries, nasal packing has been used to prevent adhesion formation and postoperatory restenosis. Even if efficient in stopping the bleeding, according to some studies, removable nasal packing has been rated by patients to be the most unpleasant aspect of the ESS surgical experience[1,2]. This may be the reason why some surgeons advocate not packing the middle meatus[3], whereas others continue to use this technique to prevent middle turbinate lateralization[4]. Controversy still exists about whether to pack or not.

This article reviews the literature on the use of both absorbable and removable materials used for hemostasis after nasal surgery in the last decades, trying to reveal the advantages and also the week points for both methods.

REMOVABLE NASAL PACKING

Even if it was used long before, the first description of nasal packing in the ENT literature was made in 1951[5], followed 18 years later (in 1969) by the use of absorbable biomaterials[6]. The ideal packing would be that which, besides of controlling the hemorrhage and acting as a barrier to adhesion formation, is easily adaptable and reasonably well tolerated by the patient.

Numerous packing agents are available, including:

- vaseline-soaked ribbon gauze;
- fingerstall packs,
- polyvinyl acetate sponge (Merocel);
- various balloon tamponade devices.

Even if, most of them are very effective in what it concerns the hemostasis, these agents cause considera-

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ble discomfort for patients, both in terms of pain and bleeding on removal[1,2,7-9]. Other complications associated with removable nasal packing include[10,11]:

- septal perforation (due to pressure necrosis);
- pack dislodgement;
- aspiration;
- toxic shock syndrome;
- foreign body granuloma;
- myospherulosis;
- obstructive sleep apnea secondary to nasal obstruction;
- death.

This is the reason why there are some very important parameters that must be take into account when using a removable nasal packing, including:

- type of the packing material;
- the aggressiveness of the packing maneuvers;
- how long the nasal packing is kept in place;
- correct setting of nasal packing in order to prevent aspiration accidents;
- antibiotic treatment during tamponade to prevent bacterial growth.

One of the most important disadvantages of removable nasal packing could be considered its impact on nasal mucosa, and especially on the ciliated mucosal surface area. Animal studies investigating the mucosal trauma caused by removable nasal packing have shown a 50% to 70% loss of the ciliated mucosal surface area in the region of the pack[12]. Therefore, a transient impairment of the patient's innate immune system, the mucociliary clearance, may be associated with the use of removable nasal packing[13].

The impact on patients' quality of life and also the possible complications of removable nasal packing have led to the ongoing development and application of absorbable biomaterials that do not require subsequent removal and still achieve positive effects on hemostasis, promote wound healing, and provide middle turbinate support.

ABSORBABLE MATERIAL NASAL PACKING

The need of reliable and safe hemostasis materials led to extensively investigations and researches on biomaterials with applicability in the ear, nose, and throat surgery, and consecutively in ESS (endoscopic sinus surgery), and this interest continues today. Both human and animal trials have contributed significantly to the understanding of these products and their role in ESS.

There are two major action mechanisms involved in the hemostasis process made by absorbable biomaterials, respectively they either provide coagulation factors or a substrate to stimulate coagulation. Other important characteristics of these agents include safety and efficacy, absorption kinetics, composition, usability (including form of the agent and delivery device) and cost.

A wide range of absorbable materials with use in nasal surgery were developed in the last years, including:

- absorbable porcine gelatin (Surgiflo, Ethicon Inc) and thrombin combination;
- carboxy-methyl-cellulose (CMC, AthroCare);
- chitosan gel (Department of Chemistry, University of Otago, Dunedin, New Zealand);
- Fibrin glue (Quixil, Omrix Co.);
- FloSeal (Baxter International Inc);
- hyaluronic acid (MeroGel, Medtronic);
- microporous polysaccharide hemispheres (MPH, Medafor Inc);
- Platelet gel (PPAI Medical);
- Surgiflo hemostatic matrix combined with thrombin;
- topical antifibrinolytics such as epsilon-aminocaproic acid (Amicar, Lederle Parenterals Inc) and tranexamic acid (Cyklokapron, Pfizer).

Table 1 summarizes the data on adhesions and wound healing.

MeroGel is an esterified hyaluronic acid found in humans in high concentration in synovial fluid and vitrous humor of the eye that gives it a well-established biocompatibility and wound healing properties. Studies[1-7] have shown that wounds heal faster and the quality of tissue repair is higher with less fibrous scarring in the presence of hyaluronic acid. This nonwoven biomaterial absorbs about 10 times its weight in blood and drainage and provides a physical matrix for clot formation.

We reviewed some studies regarding the efficacy of hyaluronic acid in what it concerns wound healing and hemostasis and adhesions in nasal surgery. Wormald and colleagues[14] performed a randomized, controlled blinded study in 42 patients with chronic sinusitis undergoing ESS. The aim of this study was to determine whether there was any benefit or detrimental consequences of placing a hyaluronic acid pack (MeroGel) into the middle meatus after endoscopic sinus surgery (ESS). The patients were randomized to receive MeroGel on one side and no packing on the other side.The reassessment was made at 2, 4, 6 and 8 weeks after surgery and the presence of synechiae, edema, and infection were noted. At no time point was the difference between the packed and unpacked sides statistically significant for any of the measures. The authors' conclusion was that MeroGel nasal packing has no significant beneficial or detrimental effect in terms of synechiae, edema, or infection when placed in the middle meatus after ESS.

Vaiman and colleagues[15] compared the hemostatic efficacy of the second generation surgical sealant, fi-

Table 1
Synthetic summary of hemostatic materials used in nasal surgery

Biomaterial	Study	Study Design	Intraoperative Hemostasis	Postoperative Hemostasis	Adhesions/Wound Healing
FloSeal[13,20,27,28,29]	18 pts[28]	Prospective (uncontrolled)[28]	Rapid hemostasis 17/18 Pts([28]) (P 5 .02819)	17/18 pts (1 req packing)[28] FloSeal same as Merocel[29]	+ adhesions and granulations
	45 pts[20-]	DB RCT[20-]			(P 5 .006)[13] +adhesions
	50 pts[29]	DB RCT[29]			(P 5 .009)[27] No effect (same as removable pack)[20-]
	20 pts[13]	DB RCT[13]			
	172 pts[27]	Retrospective[27]			
MPH[23,24]	65 pts[23] 40 pts[24]	Prospective (uncontrolled)[23] SB RCT[24]	Rapid hemostasis (30-45 s)[23]	65/65 pts[23] less bleeding on POD#1 versus untreated Side[24]	8/65 adhesions[23]
Platelet gel[7]	16 pts	Prospective		16/16 pts (same as Merocel)	No adhesions (same as Merocel)
CMC mesh[30,21,31]	15 pts[30]	Prospective (uncontrolled)[30]	20% persistent bleeding([30])	15/15 pts[30] 41/41 pts (same as no pack)[21]	No adhesions[30] No effect (same as no pack)[31]
CMC gel[21,31]					
Epsilon-aminocaproic acid[32-]	10 pts	DB RCT	Ineffective versus saline	10/10 pts	—
Tranexamic acid[32]	10 pts	DB RCT	Better versus saline (P<.05)	10/10 pts	—
Sepragel sinus[33]	20 pts	RCT	Same as no treatment	—	—
Quixil (fibrin glue)[8,15,34]	158 pts[8] 64 pts[15]	DB RCT[8] Prospective (controlled)[15]	Same as Merocel[8]	Better than Merocel (3.12-4.65% vs.22.9-25%)[15]	Same as Merocel[15]
Polyvinylacetyl (Merocel)[7,17]	16 pts[7] 61 pts[17]	Cohort[7] SB RCT[17]	—	16/16 pts[7]	No adhesions ↓ Adhesions versus no packing (saline solution)[17]
Surgiflo/thrombin combination[19-]	30 pts	Prospective (uncontrolled)	29/30 in 10 min	29/30 (1 req packing)	No adhesions
Surgicel Nu-knit[18]	60 pts	RCT	—	60/60 pts, same as gauze and Merocel	—
MeroGel[16,35,14]	37 pts[16] 42 pts[14] 35 pts[35]	DB RCT[16] SB RCT[14] RCT[35]	— — —	— — —	Same as Merocel (3/37 adhesions)[16] Same as no pack[14] Same as removable pack[35]
Gelfilm[36,37]	115 pts[36] 51 pts[37]	Prospective (controlled)[36] RCT[37]	— —	— —	+ adhesions verus MeroGel (P<.05)[36] +granulations versus no pack (P<.05)[37]

brin glue (Quixil), to that of nasal packing (Merocel) in endonasal surgery in a prospective randomized trial that included 494 patients, showing that fibrin glue is superior to nasal packing in controlling the postoperative hemorrhage (postoperative hemorrhage occurred in 22.9-25% of patients with nasal packing vs. 3.12-4.65% in the fibrin sealant groups (late hemorrhage only)), but with comparable results in the incidence of adhesion formation between the arms.

Miller and colleagues[16] compared Merocel pack (5-7 days) and hyaluronic acid (MeroGel). Patients underwent follow-up at 8 weeks postoperatively. Results showed both packing agents were associated with an 8% adhesion rate[16]. This finding contrasts with those of Vaiman and colleagues[15] and Pomerantz and Dutton[7] which showed no evidence of adhesion formation with Merocel packing. Discrepancies between these studies may be related to the timing of pack removal.

The effects of non-absorbable nasal packing (Merocel) on adhesions formation and wound healing process was assessed by Bugten and colleagues[17] in a randomized, partly blinded, controlled clinical trial. Video recordings taken 10 to 14 weeks after surgery

showed 7 of 62 adhesions in the Merocel arm versus 29 of 54 adhesions in the no packing arm, a finding that was highly significant (P = .001). Other outcome variables assessed in this study were nasal congestion, nasal pain, and headache the first 2 weeks, rated on visual analogue scales (VAS; 0-100). The authors showed that nasal congestion decreased most the first 5 to 7 days postoperatively and the removal of the Merocel caused little pain (mean 23 on VAS) to the patients.

Oxidized regenerated cellulose (Surgicel Nu-knit, Ethicon Inc, USA) has been studied for its effects on hemostasis after ESS. In this regard, Shinkwin and colleagues[18], in a randomized, prospective trial that included 60 patients, compared Surgicel Nu-knit (placed in one nostril) with Vasolene ribbon gauze and Merocel packs (randomized in the other nostril). Twenty-four hours postoperatively, patients were asked to assess the discomfort experienced in either side of the nose while the packs were in position and on removal. The length of time and estimated amount of bleeding following removal of packs were also assessed. Surgicel Nu-knit caused significantly less discomfort both while in position and on removal than Vasolene gauze ($p < 0.01$, respectively). Compared to Merocel sponges, Surgicel Nu-knit caused significantly less discomfort on removal ($p < 0.01$). Bleeding following removal was also significantly less compared to the other packs.

A multicenter, prospective, single-arm study that included 30 patients[19], evaluated the success in achieving hemostasis within 10 minutes of application of a combination of Surgiflo (sterile, absorbable porcine gelatin) with thrombin in patients undergoing elective primary or revision endoscopic sinus surgery for chronic sinusitis. The results showed that Surgiflo hemostatic matrix with thrombin was clinically effective in controlling bleeding in 96.7% of patients (29/30 pts.) and also no complications, such as synechiae, adhesion, or infection, were reported.

FloSeal is a topical hemostatic agent consisting of gelatin matrix (bovine-derived) combined with human derived thrombin. Jameson and colleagues[20] in an randomized, double-blinded, controlled study, evaluated its effect on bleeding and healing after functional endoscopic sinus surgery. The results showed that the use of this hemostatic agent produced less bleeding, immediately postoperatively, less discomfort and did not increase the incidence of crusting or scarring compared with control.

Carboxymethylcellulose (CMC) nasal packing was developed in 2001, with its postulated ability to promote hemostasis by platelet aggregation. Regarding the hemostatic abilities of CMS, in the literature there are some contradictory results. If Kastl and colleagues[21] in an investigator-initiated, randomized, single-blinded, controlled, prospective clinical study, comparing CMC nasal packing with no packing at all, did not find any statistical significant difference, Szczygielski and col.[22] reported that dissolvable CMC foam dressing is associated with very low levels of localised pain and with low levels of postoperative bleeding and synechiae formation.

Platelet gel is a fibrin tissue adhesive product manufactured from centrifugation of autologous whole blood, producing a platelet-rich plasma. In rhinologic applications it is considered an innovative technique that holds many advantages, including comfort, hemostasis, and growth factors that may improve wound healing. Pomerantz and col.[7], in a cohort study, showed good results in the management of postoperative epistaxis after ESS using platelet gel, so that none of the patients in the study had postoperative epistaxis that required additional packing, and there were no instances of synechiae formation or exuberant granulation tissue.

Other novel absorbable agent is microporous polysaccharide hemispheres (MPH), which is produced from purified potato starch, that is rapidly absorbed and acts to quickly extract fluids from blood, thereby concentrating serum proteins and platelets at the site of injury. Its hemostatic effect was evaluated in several studies in the literature[23,24], the reports showing less bleeding in the early postoperative period with no increase in pain, obstruction, or nasal discharge, but also no increase in adhesions formation compared with control groups.

A novel chitosan gel has also been recently developed from chitin, a natural biopolymer, and is postulated to achieve hemostasis through aggregation of erythrocytes. It also has been shown to have an inhibitory effect on fibroblast proliferation[25,26]. Chitosan gel has been shown in the CRS sheep model of ESS to have produced rapid hemostasis after application and has been shown to significantly improve the microscopic features of wound healing and reduce adhesion formation after ESS in an animal model.

No published literature has investigated the hemostatic or wound-healing properties of polyethylene glycol (NasoPore, Polyganics B.V., Groningen, The Netherlands) after ESS. All other products have recently been investigated in both human and animal trials, importantly in the area of hemostasis and wound healing.

CONCLUSIONS

The ideal nasal dressing is one that is not affecting the quality of life of the patient, is hemostatic and improves healing. In practice it is very difficult, if not impossible, to find a product that meets al this features, although a number of currently available materials may address some of these characteristics.

Even if efficient in preventing nasal postoperative bleeding, removable nasal packing, regardless of the type of material, is considered by the patient to be the most unpleasant aspect of the endoscopic sinus surgery, producing discomfort and pain during the period it is in place, but also when it is removed.

This may be the reason why lately a lot of researches were conducted to develop an absorbable nasal dressing that is safe and efficient in preventing hemorrhage and adhesions, and ensures a smooth wound healing process. In this regard, important steps have been made.

But, choosing the type of nasal dressing after ESS is in the surgeon's hand and depends on his abilities, preferences and technical possibilities.

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