Platelet-rich plasma nasal packing in endoscopic sinus surgery

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Introduction
Synech ia and scarring are the most common complications encountered after endoscopic sinus surgery that may result in occlusion of sinus drainage pathway, leading to recurrent symptoms and subsequent surgical failure. Platelet-rich plasma (PRP) has been used in many aspects of medicine to accelerate healing, avoid bleeding, and prevent synechia.

Patients and methods
A total of 40 patients with bilateral sinusitis candidate for endoscopic sinus surgery were encountered in the study. The middle meatus and ethmoidal cavity at one side of the nose was irrigated using PRP, whereas the other side was irrigated with normal saline. Postoperative assessment was done by subjective (questionnaire) and objective (endoscope) methods.

Results
This study showed that PRP side was more comfortable, giving less pain, bleeding, nasal crustations, and synechiae compared with the other side of the nose irrigated with saline (control) and that was statically significant.

Conclusion
PRP is a safe and simple procedure that can improve mucosal healing and decrease postoperative synechiae, crust, and edema. It also provides better quality of life for patient by decreasing postoperative pain and bleeding.

Keywords:
crustations, functional endoscopic sinus surgery, platelet-rich plasma, sinusitis, synechia

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Background

Endoscopic sinus surgery (ESS) is the mainstay of surgical management for sinus pathology in the modern age. The most common reason for performing ESS is for chronic rhinosinusitis (CRS), with or without polyp disease [1].

Recently with the understanding of pathophysiology of CRS and the role mucociliary clearance, many rhinologists adopted functional sinus surgery by removal of pathology in the ostiomeatal complex to achieve ventilation and drainage and maximal mucosal preservation [2].

Overall, 10–19% of patients with CRS will require revision ESS within 5 years, 43% of them in the first postoperative year [3].

One of the most common causes of recurrence is scarring which can manifest as stenosis of the sinus ostia mostly frontal and maxillary sinuses or middle turbinate lateralization (78%) [4].

Various techniques are described to prevent postoperative synechiae. Postoperative debridement, that is removal of crusts, clots, and secretions has been shown to decrease postoperative crusting and the development of adhesions, although it increases postoperative pain [5].

One of the methods of preventing postoperative middle turbinate lateralization is the use of space occupying packing, stents, sponges, and gels [6].

A number of absorbable materials have been developed and are now routinely used after ESS [7].

Platelets are a rich source of growth factors. Applying of concentrated platelet-rich plasma (PRP) to the surgical site improve postoperative outcome by accelerating healing process, preventing synechia formation, better hemostasis, and decrease infection rate [8,9].

Multiple surgical specialties have recognized the potential benefits of platelet-rich concentrates. Their use has been described in ophthalmology, neurosurgery, general surgery [10], orthopedic, and sports medicine to relieve pain [11]. Dermatologists have successfully used PRP for facial rejuvenation and for the treatment of various dermatological disorders [12].

Otolaryngologists have recently studied the role of PRP in tympanoplasty, cerebrospinal fluid rhinorrhea repair turbinoplasty, and ESS [13–15].

Pomerantz and Dutton [9] claimed the usage of platelet gel as a packing material after ESS offers efficient hemostatic properties, advances the healing process, and improves postoperative quality of life.

When adding PRP at the end of intranasal surgeries, which leave a large raw surface especially after ESS, there will be less bleeding, crust formation, and a greater improvement of nasal mucociliary clearance (NMC), which decrease the incidence of recurrence. It is simple and easy to be prepared with no reported adverse effects [13,16].

Aim

The aim is to evaluate the efficacy of using PRP after ESS by subjective assessment of pain, nasal blockage, and bleeding, and objective assessment by endoscopic evaluation of mucosal healing process postoperatively.

Patients and methods

This is a prospective cohort randomized study in which 40 patients were recruited from the ENT Outpatient Clinic, School of Medicine, Cairo University, in the period from September 2019 till February 2020. All the patients had CRS with or without polyps according EPOS 2012 with symptoms such as nasal obstruction, discharge, facial pain, headache, and loss of smell for at least 12 weeks. The diagnosis was confirmed by nasal endoscopy and computed tomographic (CT) scan of the nose and paranasal sinuses.

A written informed consent for treatment was taken before enrollment, and the study was approved by Research Ethical Committee in Faculty of Medicine at Cairo University.

PRP was introduced intraoperatively in one side of the nose of 40 patients acting as study group (allocated randomly), and saline was used in the contralateral side which acts as the control group.

Exclusion criteria included patients with unilateral sinonasal pathology, significant asymmetric CT in the sinus disease (Lund-McKay score difference >2), and recurrent cases.

All patients were subjected to a preoperative assessment protocol that included full history taking to confirm diagnostic criteria set up by the European position paper on rhinosinusitis and nasal polyps (EPOS, 2012) for the diagnosis of CRS. The presence of sinonasal polyps and their extent and severity using Meltzer polyp grading system were assessed by endoscopic nasal examination.

All patients had undergone CT scanning of the nose and paranasal sinuses, axial and coronal cuts with high resolution and slice thickness of 5 mm with bony and soft tissue windows to assess number and degree of sinus opacification with the use of the Lund-Mackay scoring system.

All cases were subjected to bilateral symmetric functional ESS under general anesthesia. At the start of surgery, 20 ml blood was drawn from patient and placed into tubes containing anticoagulant (sodium citrate) to be processed using laboratory centrifuge (Scientific System LC-04R, manufactured in China). The blood was centrifuged on two sessions. The first one called soft spin at 2500 rpm for 5 min, which separates blood into three layers. The intermediate layer is the PRP layer 'the Buffy coat.' It is transferred into another tube without an anticoagulant and subjected to the second centrifugation; called 'hard spin' at 3500 rpm for 10 min. The acellular plasma (80% of the volume) is found at the top, most of which is removed with a syringe and discarded. The remaining 1–2 ml of plasma was used to suspend the concentrate of platelets, as shown in Fig. 1.

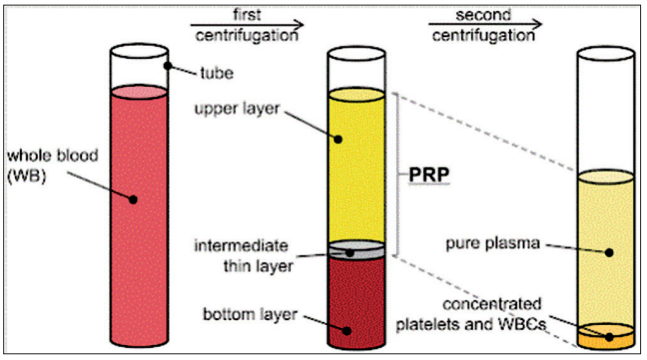
At the end of the procedure, the middle meatus and ethmoidal cavity at one side of the nose were irrigated using PRP. The contralateral side of the nose was irrigated with normal saline according to a randomized assignment.

Clinical follow-up visits were performed 1 week and 1 month after surgery. The assessment was focused on comparing the side of the nose with PRP and the other side.

Postoperative bleeding was graded from 0 to 3 objectively while removing the nasal pack after 48 h.

Patients were asked to complete a questionnaire in their first postoperative visit (after 7 days); this questionnaire was related to their subjective assessment of three criteria: pain by pain numerical rating scale, nasal

Figure 1



Step process of centrifugal separation of the whole blood in a tube for preparation of PRP [16]. PRP, platelet-rich plasma.

blockage by Nasal Obstruction Symptom Evaluation Scale (NOSE), and nasal bleeding. This questionnaire was repeated in the next visits.

Nasal endoscopic examination was done also in each visit to evaluate postoperative healing process by applying the Lund-Kennedy endoscopic scoring system, which is a three-point scale (0, 1, and 2) comprising five items, including polyps, discharge, edema, scarring and crusting. The sum of the scores for these items was calculated, and healing was estimated as a whole.

Statistical analysis

Data were collected, tabulated, and statistically analyzed by using the program SPSS for Windows (version 11 IBM, New York , USA) to compare the side which was packed with PRP and the control side. The independent samples Student *t* test was used for statistical analysis for all our parametric variables.

Results

A total of 40 patients were included in the study, comprising 18 males and 22 females. Their age ranged from 19 to 63 years old, with mean age of 27 years.

There were 23 patients with bilateral CRS with sinonasal polyps (CRSwNP), 13 patients with bilateral CRS without polyps (CRSsNP), and four patients with bilateral allergic fungal sinusitis.

Bleeding during pack removal after 2 days was much lesser in the PRP side (study group) than the contralateral side (control). This difference was statistically highly significant (*P*<0.001).

Postoperative pain scores 1 week after the operation was less in the PRP side (study group) than the contralateral side (control), with *P* value of 0.024 (not statistically significant). Moreover, there is no statistically significant difference between both groups regarding nasal obstruction after 1 week (Table 1).

Regarding endoscopic findings 1 week after the operation, nasal discharge was statistically significant higher in the contralateral side (control), and also edema was significantly lower in the PRP side (study group). Scarring and crustations are significantly lesser in the PRP side (study group) than the contralateral side (control), whereas there was no difference between both groups regarding presence of polyps (Table 2).

The overall Lund-Kennedy score of postoperative endoscopic assessment of nasal cavity after 1 week was much higher in the PRP (study group) than that of the contralateral side group. This was highly statistically significant, with *P* value less than 0.001 (Table 3).

Postoperative pain scores 1 month after the operation was significantly lesser in the PRP side (work group) than the contralateral side (control), with *P* value less than 0.001. There is no significant difference between both groups regarding nasal obstruction (Table 4).

Regarding endoscopic findings 1 month after the operation, scarring, crustations and edema were lesser in the PRP side (work group) than the contralateral side (control), and this was statistically significant.

Table 1 Comparison between both groups after 1 week regarding postoperative pain score and nasal obstruction score

Pain score (10)_1 week	Group	*n*	Mean	SD	*P*
	PRP	40	2.75	2.715	0.024
	Contralateral side	40	3.98	1.993	
NOSE score 1 week	PRP	40	1.50	2.320	0.233
	Contralateral side	40	2.25	3.193	

NOSE, Nasal Obstruction Symptom Evaluation Scale; PRP, platelet-rich plasma.

Table 2 Comparison between both groups after 1 week regarding postoperative endoscopic findings

	Groups				*P*
	PRP side		Contralateral side		
	Count	%	Count	%	
Polyps 1 week	0	0	0	0	
Discharge 1 week					
No discharge	17	42.5	0	0	<0.001
Clean thin discharge	23	57.5	40	100	
Edema 1 week					
Absent	3	7.5	0	0	0.010
Mild	37	92.5	34	85	
Severe	0	0.0	6	15	
Scaring 1 week					
Absent	34	85	31	77.5	0.001
Mild	6	15	0	0	
Severe	0	0	9	22.5	
Crustation 1 week					
Absent	3	7.5	0	0	<0.001
Mild	37	92.5	7	17.5	
Severe	0	0	33	82.5	

PRP, platelet-rich plasma.

Table 3 Comparison between both groups regarding Lund-Kennedy score after 1 week

Lund-Kennedy score (10)_1 week (endoscopic assessment)	Group	*n*	Mean	SD	*P*
	PRP side	40	2.58	0.747	<0.001
	Contralateral side	40	4.34	0.874	

PRP, platelet-rich plasma.

However, there was no difference between both groups regarding presence of polyps or nasal discharge (Table 5).

The overall Lund-Kennedy score of postoperative endoscopic assessment of nasal cavity after 1 month was much higher in the PRP (study group) than that of the control group. This was highly statistically significant, with *P* value less than 0.001 (Table 6).

Discussion

Approximately 25% of patients who experience adhesion formation after ESS will require revision surgery [17].

Table 4 Comparison between both groups after 1 month regarding postoperative pain score and nasal obstruction score

Pain score (10)_1 month	Group	*n*	Mean	SD	*P*
	PRP	40	0.13	0.791	<0.001
	Contralateral side	40	3.83	3.202	
NOSE score 1 month	PRP	40	0	0	0.323
	Contralateral side	40	0.38	2.372	

NOSE, Nasal Obstruction Symptom Evaluation Scale; PRP, platelet-rich plasma.

Table 5 Comparison between both groups after 1 month regarding postoperative endoscopic findings

	Groups				*P*
	PRP side		Contralateral side		
	Count	%	Count	%	
Polyps 1 month	0	0	0	0	
Discharge 1 month					
No discharge	14	35	8	20	0.133
Clean thin discharge	26	65	32	80	
Edema 1 month					
Absent	35	87.5	24	60	0.005
Mild	5	12.5	16	40	
Scaring 1 month					
Absent	36	90	18	45	<0.001
Mild	0	0	22	55	
Severe	4	10	0	0	
Crustation 1 month					
Absent	28	70	10	25	<0.001
Mild	12	30	30	75	
Severe	0	0	1	2.5	

PRP, platelet-rich plasma.

Table 6 Comparison between both groups regarding Lund-Kennedy score after 1 month

Lund-Kennedy score (10)_1 month (endoscopic assessment)	Group	*n*	Mean	SD	*P*
	PRP side	40	1.28	0.847	<0.001
	Contralateral side	40	2.50	0.877	

PRP, platelet-rich plasma.

Middle meatal patency with a well-healed mucosa in addition to good surgical technique is the mainstays of optimal surgical outcomes. Nasal packing and postoperative care play crucial roles in better healing process and overcoming disease recurrence [18].

The ideal material to be used for packing of middle meatus after ESS should have hemostatic properties, promotion of wound healing, resistance to bacterial colonization, and easy removal [18].

Platelet gel is an autologous source of concentrated platelet-derived growth factor and tumor necrosis factor alpha that has an important role in accelerating the rate and degree of surgical wound repair and minimizing the risk of postoperative bleeding and infection complications and improving quality of life after ESS [9].

It is an absorbable material that does not require the removal thus reducing infection, swelling, pain, and bruising. It also fastens wound closure and provides hemostasis [9,19].

This study was designed to evaluate the effect of PRP on the patient's comfort, homeostasis, and wound healing and scarring after ESS by comparing the two sides of the same patient to unify all other factors.

Endoscopic evaluation for the both middle meatuses showed significant decrease in synechia formation, discharge, edema, and crustations in PRP side in the early visits after 1 week. However, the difference between the two sides regarding discharge was not statistically significant at 1 month postoperatively.

Subjective assessment showed better results in the nasal cavity with PRP regarding pain and headache and nasal blockage. However, it was statistically significant for pain only rather than obstruction.

Bleeding assessment on pack removal on day 2 also showed statistically significant difference between both sides, with better results in the side of PRP.

In 2005, Pomerantz and Dutton published a retrospective study where 16 patients who had ESS for chronic sinusitis received platelet gel for their sinus packing compared with 16 control patient regarding quality of life survey by 'SNOT16' (Sinonasal Outcome Test, 16 question) which were documented before and after surgery. There were no cases of synechia. None of the cases developed postoperative bleeding necessitating packing. Although the difference was not statistically significant because of a small population, the quality of life scores did show improvement over the control group [9]. This matches the results of this study.

In 2012, Salaheldin and Hussein conducted a prospective randomized single-blinded study to determine the effectiveness of application of topical PRP following submucous diathermy. The study was done on 60 patients divided into two groups, 30 of them had PRP after submucous diathermy. Follow-up was done after 3 days postoperative, and then at 1 week, 2 weeks, 1 month, and 2 months consecutively. They found that crust formation and bleeding were lesser in the PRP group. They concluded that NMC improved statistically more significant in the group that was packed with PRP [20]. These results were comparable to this study.

In agreement with this study, Kumar in 2017 performed a single-blinded, randomized, prospective study, where 74 patients received PRP following septoplasty and compared with the same number of control group. NMC was improved in both the groups, but there was a statistically significant early restoration of NMC in the PRP group. Crust formation was lower in PRP group. He concluded that application of PRP is an effective method of improving NMC function in patients undergoing septoplasty, decreasing the time taken to return to normal nasal function [13].

In 2017, Kuzucu and colleagues studied 53 patients underwent nasal surgery. Twenty-seven of them had PRP packing, whereas 26 patients were included in the control group. Postoperative follow-up was done by comparing the Nose Obstruction Symptom Evaluation (NOSE) score, degree of bleeding, pain, and crust rate of the two groups. After 1 month, the PRP group experienced better results in terms of NOSE scale, less bleeding, and crust formation, which were statistically significant. However, there was no statically significant difference regarding visual analog scale score of pain [19].

In 2006, Rice and Dale evaluated the effect of PRP on mucosal healing in ESS by comparing two sides of 30 patients with bilateral, symmetrical CRS who underwent ESS. After 13 operations, follow-up evaluations demonstrated no benefit to the use of PRP, and the study was terminated early. They found that both sides healed quickly and uneventfully as expected. This does not match the results of this study. This may be owing to the small sample size and early termination of the study, and also they did not clarify the method of preparation of PRP, which varies greatly and may influence the results if not probably harvested [21].

The previous studies showed that PRP had its own advantages and disadvantages. Most studies recommended the use of PRP at the end of ESS to decrease the incidence of postoperative crusts, scarring, and bleeding, whereas others did not recommend it. However, this study recommended that using PRP is better than not using it at all, although the follow-up period was short (1 month), so we do recommend to increase the follow-up period in the coming studies to be at least 2 months to give time for complete mucosal healing and regaining normal mucociliary clearance.

Conclusion

Using PRP after sinus surgery is a simple, easy, and cheap procedure that decrease post-ESS synechiae, crust, and edema. It also provided better quality of life in the early postoperative period by decreasing incidence of postoperative pain and bleeding.

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Conflicts of interest

There are no conflicts of interest.

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