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OTOLOGY

Effect of platelet rich plasma on healing of mastoid cavity after canal wall down mastoidectomy

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Abstract

Objective To assess the effectiveness of platelet rich plasma (PRP) in promoting epithelialization and healing of mastoid cavity after canal wall down mastoidectomy.

Subjects and methods This study was applied on 20 patients with chronic sappurative otitis media who were operated by canal wall down mastoidectomy and PRP was added along sidewalls of the mastoid cavity. The patients were followed up clinically by otoscopic examination every 2 weeks for 4 months for detection of complete healing, otorrea or crustations.

Results During the follow up period, all cases show early epithelialization and good healing of the mastoid cavity with no infection; wound dehiscence, granulation tissue formation, otorrea; or debris accumulation.

Conclusion Coating the bare bony wall of the opened mastoid cavity after CWD mastoidectomy by PRP is a novel and effective method promoting healing and decreasing mastoid cavity problems.

Keywords Mastoidectomy · Cholesteatoma · Crustations · Platelet rich plasma · Epithelialization

Introduction

Canal wall down (CWD) tympanomastoidectomy is commonly used to treat advanced chronic otitis media or cholesteatoma. The advantages of CWD mastoidectomy include excellent exposure for disease eradication and postoperative control of residual disease [1, 2]. Depending upon the extent of mastoid cavity and size of external auditory canal, the self-cleaning process of mastoid cavity may be disturbed, leading to recurrent infections, secretion, vertigo, hearing impairment, and frequent consultation of the ENT specialist [3]. Therefore, to eliminate the cavity related problems and improve the long-term stability of mastoid, significant modifications were introduced including mastoid obliteration technique, canal wall up mastoidectomy and modified radical mastoidectomy.

For successful obliteration, without complications or recurrence, there should be high confidence of disease clearance all over the area to be obliterated. Definitive eradication of cholesteatoma from the mastoid air cells may be challenging in some situations like congenital cholesteatoma with its characteristic skip or satellite lesions, also in some recurrent cholesteatomas where the pathology may consist of multiple sacs [4]. Obliteration of the mastoid in these situations will definitely lead to late advanced and even complicated recurrences [5]. Regarding canal wall up mastoidectomy, it offers an alternative procedure for management of localized cholesteatomas like posterior tympanotomy for limited facial recess lesions and endoscopic procedures to control sinus tympani cholesteatoma or limited attic involvement [6]. Modified radical mastoidectomy (MRM) has been described in 1910 by Bondy in which a common cavity formed of the mastoid bowel, attic and the external auditory canal is obtained. This cavity is lined by skin which covers also the new tympanic membrane or graft isolating a middle ear space. This procedure is mainly done to get dry silent or healthy cavity and functioning sound conduction system [7]. MRM is recommended in instances with incurable illness, a posterior canal wall that cannot be rebuilt, insufficient patient follow-up, and poor Eustachian tube function [8]. The purpose of every open cavity procedure is to exteriorize the mastoid cavity for future monitoring of recurrent cholesteatoma, provide drainage for unresectable temporal bone

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infection and occasionally, provide exposure for difficult to access areas of temporal bone [9]. But failure of healing and complete epithelialization leads to various cavity problems such as vertigo, otorrhoea, hearing impairment, wax/debris collection, dependency on doctor for repeated cleaning of cavity, difficulty in wearing hearing aids and residual/recurrent disease [10].

PRP could accelerate tissue regeneration and promote soft tissue healing; thus PRP was used in soft tissues otological procedures with good results, moreover, PRP could promote the regeneration of mineralized tissues [11–14].

In this current study, the authors tried to solve the open cavity problems after CWD mastoidectomy by using platelet rich plasma (PRP) as a coating layer for bony open wound surface of the newly created cavity aiming for enhancing the healing and epithelialization process of the open mastoid cavity through the presence of high concentrates of autologous growth factors in PRP.

Patients and methods

This study was conducted from April 2022 to October 2024 at the Otorhinolaryngology–Head and Neck Surgery Department, Zagazig University. It included 20 patients with chronic suppurative otitis media who were prepared for CWD mastoidectomy with meatoplasty to treat cholesteatoma, extensive granulation tissues, patients with complicated otitis media and recurrent disease. Early retraction pocket was not included in the study as this category of patients could be managed conservatively or by less invasive surgery other than CWD mastoidectomy. Informed written consent was obtained from the patients and IRB approval was obtained. Full otological evaluation (including otomicroscopic examination) was followed. Pure-tone audiometry thresholds were determined and the air–bone gaps were calculated. Computed tomography (CT) scanning of the temporal bone was requested for all patients, aiming at detection of the disease and definition of surgical landmarks. All patients were operated by CWD mastoidectomy, the procedure began via a postauricular incision with complete eradication of the disease with a satisfactory lowering of the posterior canal wall down nearly to the level of the facial nerve and adequate meatoplasty was designed.

The PRP was prepared; 5 mL of peripheral venous blood was drawn from the patient with a 16- to 18-gauge syringe. The collected blood was put in 5-mL tubes (without an anticoagulant or calcium). Tubes were immediately centrifuged in a tabletop centrifuge (Low Speed Centrifuge [800]; Jiangsu Zhengji Instruments, Jiangsu, China) machine for 12 min at 3200 rpm. Blood would separate into the 3 layers: the bottom layer (red blood cells), the middle layer (PRP; platelets and white blood cells), and the top layer (platelet-poor plasma). The PRP layer was extracted just before application.. Then the PRP plug was mixed with prepared strips of Gelfoam to allow the Gelfoam pieces being saturated by the PRP then this pieces saturated by PRP were applied over the bared walls of mastoid cavity as a carpet, extreme care was taken in order to avoid leaving areas of bone exposed of the neocavity. An external meatal pack was placed. The post-auricular incision was closed in layers.

All patients were sent home in the following morning. Dressings, and stitches were removed 7 to 10 days and the external aural pack was removed after 2 weeks postoperatively. Prophylactic systemic oral antibiotic (amoxicillin clavulininc acid) was given to all patients till the dressing and stitches were removed, no topical ear drops were used after removal of the external aural pack. Otoendoscopic examinations were performed every 2 weeks for 4 months then at 6th and 12 th month postoperative. Assessment of complications of packing removal (bleeding, and pain or discomfort), and also the healing status of the neocavity was analyzed by examination for presence of granulation, bloody and/or purulent otorrea, or crustations (Fig. 1).

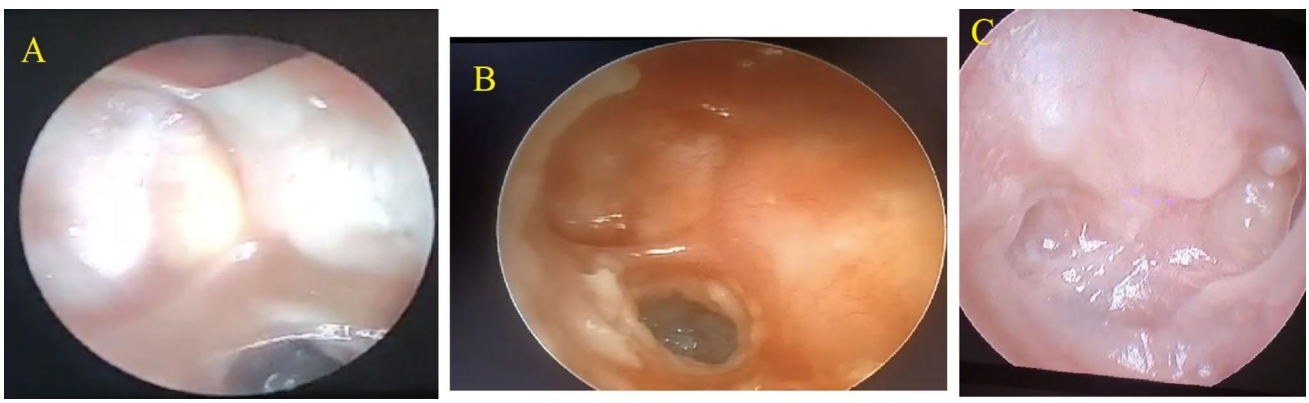

Fig. 1 Post operative view; (**A**) 3 weeks postoperative, (**B**) 4 weeks postoperative, (**C**) 8 mothns postoperative

Results

This study included 20 patients: 9 (45%) males and 11 (55%) females. The mean age of the patients at the operation was 31 (+ 7.2 SD) years (range: 19–55 years). Most of the studied patients (16 patients, 80%) had a unilateral disease; the right side was dominant (14 [70%] patients). Four (20%) patients had bilateral disease. We only operated one ear at a time. 4 (20%) patients were operated as a revision cases due to recurrent cholesteatoma, during the surgery of these revision cases, 3(75%) of them had relatively high facial ridge and 1(25%) inadequate meatoplasty. All included patients complained of persistent offensive discharge (4 of them had blood-stained discharge). Basic clinical and otomicroscopic examination data are presented in Table 1. Retraction pockets were the commonest finding (60%). Air– bone gaps ranged between 25 and 45 dB (with a mean of 32 + 2.1 dB). Preoperative CT scans show soft-tissue mass with varying levels of bone erosion or destruction in all patients. Sclerotic mastoid was found in 8 (40%) patients. Outer attic wall destruction was seen in all studied patients. Ossicular necrosis was detected in 12 (60%) patients.

The early postoperative period (4–6 weeks) had passed smoothly. There were no reports of wound infections, dehiscence, or hematomas. At the time of packing removal after 2 weeks postoperative all patients did not present any bleeding or discharge from the ear, endoscopic examination of the open cavity revealed the presence of a thin layer of fibrin on the neocavity as an early attempt of healing also, the surface was smooth with evidence of gelfoam remnants was present. At the 4th weak postoperative all the patients had dry smooth cavity with no evidence of granulation, crusts, nor discharge. Complete epithelialization and healing was reached by 4th weeks postoperative. In all patients, no signs suggestive of recurrence were detected. 2 (10%) patient had recurrent discharge; it was not offensive and was managed successfully by topical antibiotic/steroid ear drops for 7 days. Residual TM perforations were detected in 2 (10%) patients, they were prepared for revision surgery to close the TM perforations after 6 months; during surgeries, no keratin pearls nor granulation tissues were detected and closure of the perforation was successfully done via perichondrial grafts.

Table 1 Clinical data of the patients

Symptom/sign	Number	Percent
Offensive discharge	20	100%
Blood stained otorhea	4	20%
Hearing loss	13	65%
Retraction pocket	12	60
Attic perforation	5	25%
Posterosuperior perforation	9	45%
Keratin pearls	13	65%
Granulation tissue	9	45%
External canal polyp	5	25%
Revision cases	4	20
Complicated otitis media	1	5%

Discussion

Canal wall down mastoidectomy techniques are associated with low rates of recurrent disease, but the risks of discharging cavity problems are frequently reported (20% to 60%) [15].

The majority of research studies were concerned with solving open cavity problems by reconstruction of posterior canal wall and obliteration of mastoid cavity after CWD mastoidectomy excluding cases like recurrent cholesteatoma, complicated otitis media, and congenital cholesteatoma from these studies due to the challenge of complete eradication of the pathology but in this current study the authors have offered a new solution for these cases who in critical need for maintaining the open cavity and in the same time reducing cavity problems by promoting the healing and epithelialization process of the neocavity by coating its raw bony surfaces by PRP by its high concentrates of autologous growth factors.

The bone exposed after mastoidectomy secrete tissue fluids that provide the perfect environment for the development of bacterial infection thus discharging cavity would be resulted [16]. Moreover, the rough surface and pockets in the mastoid cavity alters the epithelial migration process resulting in debris accumulation within the cavity [17]. So, if the bare bony wall of the mastoid cavity is carpeted and covered with a material promoting healing and neovascularization like PRP by its high contents of growth factors, we could have positive outcomes for cavity-related issues and shorter healing times without need for cavity obliteration.

The current study results agree with De Sousa et al. [18] who used a latex biomembrane to coat the bony wall of mastoid cavity where postoperative pack removal was easy and comfortable to all patients with no pain nor bleeding due to the healing effect of the PRP coating the bony wall of the cavity. It is very likely that the bleeding and the granulation tissue were responsible for the delay in neocavity epithelialization. In this current study, the authors used strips of gelfoam saturated by PRP to act as an interface that will protect the neocavity surface coated by PRP from being traumatized during pack removal thus creating a more suitable surface to promote the epithelialization process.

In the current study, the neocavity epithelialization happened successfully in all patients at the 4th week without any evidence of granulation or otorrea while, the study of De Sousa et al [18] granulation tissue was seen at 30 th day postoperative

in 14.8% of the cases in which the latex bio membrane was used and at 60 days after surgery, (9.3%) of the cases still presented areas of granulation tissue on the neocavity surface. In a study of Kumar R etal [19] compared the outcomes of obliteration of mastoid cavity using vascularised periosteotemporofascial swing flap with medicated bone dust versus open mastoid cavity only (40%) of obliterated cavities had been completely epithelialized by the end of third week moreover, 4% of open cavity patients only have been completely epithelialized and 92% of obliterated cavities were healed completely within 6 months compared with 72% of the healed cavities for the open cavity patients. This clearly demonstrated that coating the bony wall of the neocavity by PRP promotes the epithelization and healing rapidly and successfully.

This proposed new technique is readily available, easy, less costly, and economic. However, further studies on big sample size with longer follow up period and futher randomized control studies are needed for better assessment of this procedure.

Conclusion

Coating the bare bony wall of the opened mastoid cavity after CWD mastoidectomy by PRP is a novel solution for open cavity problems via a good and effective method with better outcomes in terms of postoperative discharge, and wax formation besides promoting early cavity epithelialization. With this method, it is possible to decrease the load on ENT OPD services (in terms of early frequent post-operative follow up visits) since the cavities will require less dependency on doctors, that too for a shorter period of time.

Authors contributions Mohammad El-Sayed Abd Elbary'; suggest and develop the research idea, do the operation, review literature, prepare and follow up the patients, consent patient, taking the IRB approval, collect data, tabulate data, assist in wring the manuscript. Ibrahim Ahmed Khaled; review of literature, revise written manuscript, data interpretation, Mohammad Waheed El-Anwar; modify the idea, review literature, assist in writing the manuscript, interpretation of data, revise the manuscript. Hoda Ismael Abdelhamid; develop the research idea, assist in the surgery, assist in writing the methodology, data interpretation, revise the written manuscript.

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Declarations

Research involving human participants and/or animals Approval from the Zagazig University institutional review board committee (ZU-IRB #10272) was obtained.

Informed consent All included patients signed an informed consent before involvement the study.

Conflict of interest The authors declare no conflict of interest.

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