CHEMICAL CAUTERIZATION WITH SILVER NITRATE IN CLOSING SMALL DRY TYMPANIC MEMBRANE PERFORATIONS

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ABSTRACT

Objective: To compare the effectiveness of chemical cautery by silver nitrate with spontaneous closure in small and dry tympanic membrane perforations.

Study Design: Quasi experimental study.

Place and Duration of Study: The study was conducted at ENT department, Combined Military Hospital Jhelum, from Jan 2016 to Dec 2017.

Methodology: Sixty four patients of either gender, with unilateral, pin hole and dry tympanic membrane perforation in the pars tensa were selected. Written, informed consent was taken and hospital ethical committee approval was obtained. Patients were divided randomly into two groups of 32 patients each. Patients in group A were treated with silver nitrate. Patients in group B were reassured for spontaneous closure. Success rates in both groups were recorded. Impact of age, gender, laterality, etiology and duration of perforation on successful healing in both groups was assessed.

Results: The success rate in group A was significantly higher than group B (*p*-value 0.0057). The proportion of traumatic perforations was significantly higher in the successful cases of both groups (*p*-value for group A 0.0180 and for group B 0.0183). In group B significantly more patients were able to achieve spontaneous closure in whom the perforation was <4 weeks old (*p*-value 0.0047).

Conclusion: Chemical cautery with silver nitrate was an effective means of treating small dry tympanic membrane perforations. Traumatic perforations and those <4 weeks have a higher chance of spontaneous closure.

Keywords: Cautery, Silver nitrate, Tympanic membrane perforation.

INTRODUCTION

The tympanic membrane forms a partition between the external acoustic canal and the middle ear. Vibrations of the tympanic membrane are transmitted to the stapes footplate through a chain of ossicles coupled to the tympanic membrane[1]. Tympanic membrane perforation results usually from trauma to the ear or infection[2]. Traumatic perforations may be caused due to hair pins, match stick, unskilled attempts to remove a foreign body, sudden changes in air pressure like slap on the ear or sudden blast, diving, water sports, forceful syringing or fracture of temporal bone. Infective causes result from acute or chronic suppurative otitis media[3]. Tympanic membrane perforations can result in conductive deafness and thus significantly impair the patient's quality of life. Keeping the above in view repair of tympanic perforations is required to avoid morbidities such as deafness and ear discharge[4].

Various materials have been used by different surgeons in an attempt to repair a perforated tympanic membrane like pig's bladder (Banzer in 1640), rubber disc (Toynbee in 1853) and paper patch (Blake in 1877)[5].

Cauteryof the tympanic membrane and patch techniques have been used by many otolaryngologists for treating small dry tympanic membrane perforations. One of the cauterizing agents is silver nitrate. Silver nitrate is an antiseptic, inorganic chemical. When applied to a wet surface, it forms nitric acid which has a chemical cauterizing effect[6].

In the present study we have compared closure outcomesof small dry tympanic membrane perforations of the pars tensafollowing

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chemical cautery using silver nitrate with spontaneous closure.

METHODOLOGY

The Quasi experimental study was conducted at the department of ENT, Combined Military Hospital Jhelum, during the period between January 2016 and December 2017. The study population included 64 patients having a unilateral, small (pin hole) and drytympanic membrane perforation in the pars tensa. A complete history was taken and a routine ENT examination was performed in all the patients including tuning fork tests.

Patients less than 18 years of age, those with bilateral perforations, discharging ears and larger perforations were excluded from the study. Similarly patients having marginal perforations, attic disease, tympanosclerosis and having comorbids like allergic rhinitis, chronic sinusitis, nasal polyposis, were also excluded.

Possible outcomes and alternative surgical options were properly explained to all the patients. Written, informed consent was taken from the patients and hospital ethical committee approval was taken.

The patients were divided into two groups randomly using computer generated random table. Patients in group A were treated with silver nitrate and gel foam whereas patients in group B were observed for spontaneous closure.

Patients in group A underwent the procedure in the ENT outpatient department. The patients were positioned in supine posture with head rotated towards the opposite shoulder. Microscope was focused onto the tympanic membrane perforation. Wax and debris were removed. A ribbon gauze wick soaked in 4% lignocaine was kept in the external auditory canal touching the tympanic membrane for about 5 minutes to anesthetize the region. Under the microscope the margins of the perforation were carefully touched with cotton tipped Jobson probe dipped in silver nitrate. On blanching of the rim margin a sterile Gelfoam film was placed in the external auditory canal covering the perforation. The patients were given oral Ciprofloxacin 500mg twice daily for 3 days. The patients were given detailed instructions to keep the treated ear dry and avoid episodes of upper respiratory tract infections. The patients were evaluated on weekly basis for five weeks, most of them required more than one application, and the technique was repeated for a maximum of four times. The procedure was considered to be successful if there was no residual perforation within the follow up period confirmed by otoscopy, tympanometry and examination under microscope.

Patients in group B were reassured and were counseled on the wait and see policy. They were also given detailed instructions to keep the ear dry and avoid episodes of upper respiratory tract infections. They were evaluated on weekly basis for five weeks. Otoscopy was performed on each visit and size of perforation was noted. Closure was confirmed on tympanometry and examination under microscope.

Primary outcome was closure of the perforation. Secondary outcomes included potential impact of age, gender, laterality of perforation, etiology and time interval since perforation on tympanic membrane healing in both the groups.

The data was analyzed using SPSS 17. Fisher exact test was used to compare the data, p value of less than 0.05 was considered to be significant.

RESULTS

The study population included 64 patients. Demographic data of the patients (table-I).

The average number of applications of silver nitrate required to achieve closure in group A was 3 (table-II).

In group A, out of the 32 patients, 3 patients were lost to followup so 29 cases were analyzed. Out of these 23 (80%) had a successful closure. Whereas in group B, 5 cases were lost to follow up. Out of the remaining 27 patients, 11 (40.7%) had spontaneous closure during the period of study. Primary outcome in both groups was shown in table-III.

Fisher exact test was used to compare the results of both groups and the difference was found to be significant (*p*-value 0.0057).

The patients who had a successful closure in group A were found to be significantly younger than those who failed to achieve closure (*p*-value <0.0001). The difference in mean ages was however not significant in group B (*p*-value 0.1032). The proportion of traumatic perforations was significantly higher in the successful cases of both groups (*p*-value for group A 0.0180 and for group B 0.0183).

There was no statistical difference with regard to gender and laterality in the successful and failure cases of both group A (*p*-values 0.66 and 0.66 respectively) and group B (*p*-values 1.00 and 0.71 respectively).

Regarding the time interval since perforation, in the spontaneous healing group (i.e group B), it was observed that significantly more patients were able to achieve spontaneous closure if their perforation was recent i.e less than 4 weeks old as compared to older perforations (>4 weeks but <6 months), *p*-value being 0.0047. The difference was however not significant in the chemical cautery group (group A), *p*-value being 0.66.

Table-IV: Secondary outcomes in both groups.

Secondary outcomes	Group A (n=29)		Group B (n=27)	
	Success (23)	Failure (6)	Success (11)	Failure (16)
Age (Mean ± SD)	28.39 ± 6.44	47.6 ± 11.6	37.18 ± 9.26	43.12 ± 8.78
Gender	Males (11) Females (12)	Males (2) Females (4)	Males (6) Females (5)	Males (9) Females (7)
Laterality of perforation	Rt (12) Lt (11)	Rt (4) Lt (2)	Rt (5) Lt (6)	Rt (6) Lt (10)
Etiology of perforation	Trauma (20) Infection (3)	Trauma (2) Infection (4)	Trauma (9) Infection (2)	Trauma (5) Infection (11)
Time duration since perforation	<4 weeks (17) >4 weeks but <6 months (6)	<4 weeks (2) >4 weeks but <6 months (4)	<4 weeks (10) >4 weeks but <6 months (1)	<4 week (5) >4 weeks but <6 months (11)

Table-I: Demographic data (n=64).

		Frequency (%)
Gender	Male	35 (54.6)
	Female	29 (45.3)
Age (years, Mean ± SD)	36.39 ± 11.1	
Laterality of perforation	Right	27 (42.1)
	Left	37 (57.8)
Etiology of perforation	Trauma	39 (60.9)
	Infection/ inflammation	25 (39.1)
Time interval since perforation	<4 weeks	46 (71.8)
	>4 weeks but <6 months	18 (28.1)

Table-II: Number of applications of silver nitrate among the patients of group A.

No. of applications of Silver Nitrate	No of patients (%)
1	1 (3)
2	7 (22)
3	15 (47)
4	9 (28)

Table-III: Successful closure in both groups.

	Group A	Group B
Successful Closure	23/29(80%)	11/27(40.7%)

DISCUSSION

Direct physical injury, pressure effects and acute infections may result in the perforation of the tympanic membrane. Iatrogenic damage can also occur, most commonly after insertion of ventilation tubes. Perforation of the pars tensa can involve any part of the membrane and can be of any size from a pinhole to total loss. Minor outpatient procedures for closing tympanic membrane perforations have a long history and rely on the natural tendency of traumatic perforations to heal themselves[7]. Chemical cauterization with silver nitrate in closing small dry tympanic membrane perforations is a non surgical

OPD procedure with results comparable to that of surgery in selected patients, whereas abates the morbidity, risks of general anaesthesia and psychological trauma. Chemical cautery to the margins of the perforation causes break up of fibrosis and promotes granulation and new tissue formation whereas the gel foam or paper patch provide a scaffold for the epithelium to grow[8,9]. It is thought to be a safe and beneficial outdoor procedure[10]. In the present study we have compared healing of pinhole dry tympanic membrane perforations after treatment with silver nitrate with spontaneous closure.

In a study by Upreti *et al* in 2018, 91.2% success rate has been reported with closure of the tympanic membrane perforations in 62 out of 68 patients treated with chemical cautery[8]. Santhi T and Rajan KV, reported a success rate of 72.2% in patients with perforations due to CSOM and 88.9% in patients with traumatic perforations, with an average of 3.2 applications of silver nitrate[11]. Similar results have been observed in the present study with better outcome in patients with traumatic perforations. In another study by El-Anwar *et al*, in 2017, topical silver nitrate cauterization was used to refresh and close small tympanic membrane perforations. Successful closure of tympanic membrane perforations was achieved in 76.9% patients[4].

Jayakumar *et al* performed a study on the closure of small central perforations of tympanic membrane in 2016, in which they compared chemical cauterization with 50% trichloroacetic acid with application of gelfilm patch and platelet rich plasma. Out of the successful cases 52.63%, belonged to the cauterization group and 47.37% belonged to gelfilm patching group[12]. This again shows the efficacy of chemical cauterization in achieving closure of small tympanic membrane perforations. Goldman NC in 2007 reported a success rate of 64% with chemical myringoplasty in 28 patients with chronic dry tympanic membrane perforations using silver nitrate and urea ointment patch[13].

In addition to silver nitrate other chemicals have also been used for chemical cautery of tympanic membrane, the most notable of which is trichloroacetic acid. Uppal *et al* in 1997 studied closure of tympanic membrane perforations by chemical cautery using saturated solution of trichloroacetic acid and reported 78% success rate with an average of 2.8 applications. The study showed better results in traumatic perforations as compared to inflammatory cases. The authors also reported definite improvement in hearing acuity and relief from other symptoms[14]. Our study also showed an overall 80% success rate in group A and the proportion of traumatic perforations was significantly higher in the successful cases of both groups (*p*-value for group A 0.0180 and for group B 0.0183).

In 2017, Singh *et al* studied the role of trichloroacetic acid and gelfoam in closure of tympanic membrane perforations and concluded that cautery and patching of tympanic membrane may be considered first line in the management of small to medium sized perforations[15]. Scaramella *et al* in 2002 reported 84.2% success rate over a period of six years by using trichloroacetic acid as the cauterizing agent[16].

Bala *et al* in 2016 used 30% trichloroacetic acid to cauterize non healing dry tympanic membrane perforations and found it to be successful in 92.5% cases[17].

In patients having tympanic membrane perforations, infection is a complication that can adversely affect the outcome at any stage of the healing process[18]. In the present study, the overall success rate was comparable to the studies documented in the literature and statistically more patients achieved complete closure of the tympanic membrane perforation who underwent chemical cautery as compared to the group observed for spontaneous closure however the following limitations were noted. The sample size was small. Furthermore 8 patients were lost to followup. Patient compliance with the post procedure instructions was not very good. Ear infection and the hot and humid climate of

Jhelum could also be a contributing factor to the failure in some of the cases.

CONCLUSION

Chemical cauterization with silver nitrate for closure of small dry tympanic membrane perforations is an effective procedure and may be considered in the management of small, dry perforations (selected patients) before going for myringoplasty. Most of the patients require more than one application.

Traumatic perforations have a better chance of healing both spontaneously and with chemical cautery as compared to perforations due to infective causes.

Recent perforations have a higher chance of spontaneous closure if they remain dry, so they may be observed for spontaneous closure for a period of 4 to 5 weeks before any intervention.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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