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Therapeutic Effect of Plasma Assisted Adenoidectomy on Otitis Media with Effusion

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1. Abstract

1.1. Background: This study aims to investigate the clinical efficacy of tympanostomy during plasma assisted adenoidectomy in children with adenoidal hypertrophy and OME.

1.2. Methods: A retrospective review of 2089 cases of childhood adenoid surgery assisted by low temperature and plasma in our hospital over the past 10 years showed that, of the 2089 cases, 245 cases with OME were treated with simultaneous intraoperative tympanometry, drug injection, suction, and external ear canal pressurization to the patency of the eustachian tube.

1.3. Results: The male to female ratio of the gender ratio in the 2089 cases was 2.08:1, with an average age of 5.87 ±3.12 years and a disease duration of 2.12±0.43 years; among these cases, 6 had adenoid I degree, 173 II degree, 642 III degree and 1268 IV degree. **2.** Among 2089 cases, 245 cases with OME, the ratio of adenoid III-IV hypertrophy with OME (12.51%, 239/1910) was higher than that of I-II degree (3.35%, 6/179), P<0.01. **3.** Intraoperative tube placement was performed in 8 patients, while the rest of them were punctured, suctioned, infused, pressurized, and ventilated eustachian tubes. During more than 1 year of follow-up, the rate of non-tube placement, one cure, was 96.73% (237/245).

1.4. Conclusion and significance: The degree of adenoid hypertrophy in children correlates with the incidence of OME. OME with adenoid hypertrophy, the vast majority of whom do not undergo tube placement, can be cured by plasma assisted adenoidectomy with needle injection of slow-release hormonal agents and pressure flush through the eustachian tube, greatly reducing tympanostomy tube complications in children.

2. Introduction

Adenoidal hypertrophy in children is easily complicated by otitis media with effusion (OME), long-term OME can easily affect the child's hearing, and in severe cases, even growth and intellectual development [1]. Mechanical obstruction of the pharyngeal orifice of the eustachian tube due to adenoidal hypertrophy, middle ear infection, and local allergy are important causes of OME in children [2], therefore, relieving the mechanical obstruction of the eustachian tube, promoting the drainage of intratympanic effusion, and restoring the function of the eustachian tube to restore the normal pressure of the middle ear tympanic cavity are the keys to the success of treating adenoidal hypertrophy with OME in children [3].There are many current treatments for OME [4], including eustachian tube inflation, tympanostomy, myringotomy and tympanostomy tube placement, among which tympanostomy tube placement is a commonly used surgical measure for the treatment of OME in children, which can quickly exclude effusion and secretions, restore the air pressure in the drum, and improve the hearing level of children, but postoperative ventilation tube blockage, detachment, postoperative ear discharge, and acute suppurative otitis media, granulation of the middle ear, tympanic membrane perforation, tinnitus and other complications [5]. In this study, a retrospective review of 2089 pediatric adenoid hypertrophy_surgery cases in our hospital over a period of nearly 10 years, 2089 cases, including 245 cases with OME, low temperature plasma assisted adenoidectomy under simultaneous otoscope assisted by tympanic puncture, drug injection, suctioning, and pressurization to the eustachian tube with patency, without tube placement, achieved 96.73% cure rate once(237/245), the vast majority of which do not

use tube placement, greatly reducing tube placement side effects, which are now reported as follows.

3. Materials and Methods

3.1. Clinical data

2089 children, 1411 males and 678 females, aged 1-14 years, with an average of 5.87±3.12 years, who underwent adenoid surgery assisted by low temperature plasma in our department from January 2004 to August 2012. All the patients showed different degrees of sleep snoring and apnea, and they were diagnosed by sleep test, endoscopy or lateral nasopharynx radiograph before operation, including 6 patients with adenoid I degree, 173 patients with II degree, 642 patients with III degree, and IV degree 1268; Acoustic immittance examination were performed preoperatively, 245 patients had OME, including 164 bilateral, 45 left, and 36 right.

3.2. Research methods

1. Surgery was performed with the assistance of the ArthroCare low temperature plasma surgical system using an ultra70 the cutting power was set to 8-grade when knife head was cut, the coagulation power was set to 4-grade, adenoidal cryoplasma resection was combined with tympanostomy treatment, and the specific operation was as follows: the child was taken in the supine position, compound general anesthesia was performed via oral intubation vein, with thin occiput under the shoulders pad, soft jelly pad on the neck to protect the cervical spine, the head was slightly retroverted, the mouth was held out by Davis opener, and the nasopharynx was raised and the soft palate was exposed via nasal application of a No. 8 urinary catheter, and cryoplasma knife was used to ablate the adenoids via oropharyngeal resection under the assistance of 70° nasal endoscopy, excision ablation along the outline of the hypertrophic adenoids, descend to the posterior fascia of the pharyngeal wall, completely resect the adenoid tissue protruding into the posterior nares, intraoperatively if there is a little bleeding, using plasma coagulation function to stop bleeding. During the operation, the abnormal eustachian tube pharyngeal folds with hypertrophic hyperplasia or flap shape lobulation were excised or remodeled, and care was taken to protect the eustachian tube pharyngeal orifice and prevent damage from causing dysfunction. 2. Concomitant with secretory otitis media, tympanic puncture was performed after completion of adenoidectomy, and the specific procedures were as follows: 75% alcohol disinfection of the outer ear canal, 7-gauge long needle in ear endoscopy, skin test syringe was used to routinely perform tympanic puncture, the thick secretion of the middle ear was tried to aspirate as much as possible with a middle ear aspirator, and then slow absorption hormone (prednisolone acetate injection) was injected into the tympanic cavity. The external auditory canal was pressurized with a self-made balloon adjustable for decompression and flushed to the patency of the eustachian tube (audible and airflow sounds through the eustachian tube, with milky drug bubbles visible in the nasal cavity). 3. Routine tympanostomy tube placement was performed in those whose eustachian tube could not be perforated by pressurized irrigation and strictly adhered to the guide for the diagnosis and treatment of otitis media in children (Draft) [6].

3.3. Criteria for adjudication of efficacy

[7] After treatment 3 to 6 months for efficacy judgment, healed: the clinical symptoms disappear, the tympanic membrane healed well the tympanometry was determined as a type of curve, can cooperate with the hearing test to pure tone test hearing, showed the air to bone conduction difference was less than 10 dB, better: the clinical symptoms decreased, the tympanic membrane healing was suboptimal, the tympanometry was determined as C type of curve, to pure tone test hearing, showed the air to bone conduction difference was greater than 10 dB; no effect: Otitis media recurred after tympanic membrane healing with no improvement in clinical symptoms and examination results, requiring re tympanic punctures or tube placement and no significant change in tympanometry before and after treatment. Total response rate = (number of recovered cases + number of better cases) / number of total cases × 100%.

3.4. Statistical methods

Excel 12010 software was used to calculate the general situation, adenoid status and surgical methods of all cases; the total effective rates before and after operation were compared, and t test in SPSS13.0 statistical software was used. The difference was statistically significant ($P < 0.05$).

4. Result

4.1. General information

Of the 2089 cases, 1411 were males and 678 were females, the male to female ratio was 2.08:1, the age ranged from 1 to 14 years, with an average of 5.87 ± 3.12 years, among which 3-7 were the most prevalent, accounting for 76.35% (1595 / 2089), disease duration ranged from 1 month to 10 years, with an average of 2.12 ± 0.43 years, the examination conditions: adenoid degree 6 cases, II degree 173 cases, III degree 642 cases, and IV degree 1268 cases, and the ratio of mild hypertrophy (I-II degree) was 8.57% (179/2089), the proportion of severe hypertrophy (III-IV degree) was 91.43% (1910 / 2089).

4.2. The relationship between adenoid hypertrophy and OME was as follows

(12.51%, 239/1910) of 2089 cases with OME, severe hypertrophy with adenoid with OME (245 cases), mild hypertrophy with OME(6 cases), proportion with effusion (3.35%, 6/179) of 2089 cases, chi square (χ^2) value 13.27, $P<0.01$) using t-test.

4.3. Operation condition

245 cases of OME, 8 with intraoperative tube placement and 3 with secondary tube placement; The remainder were punctured, medicated, suctioned, pressurized, and had their eustachian tube

(Figure A-D), and 237 cases were reviewed at around 3 months after surgery when the tympanic membrane morphology had returned to normal (Figure E). During follow-up of more than 1 year, non-tube placement was associated with a cure rate of 96.73% (237/245) once.

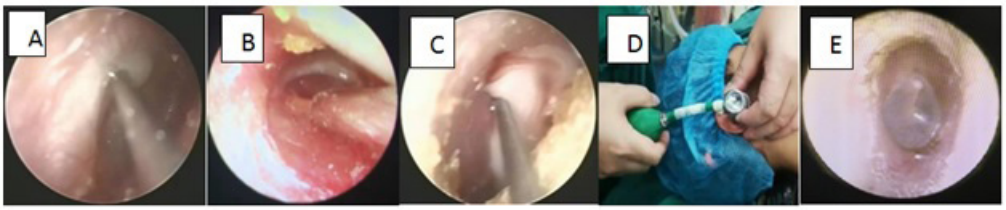

Figure 1: A. Tympanic membrane puncture; B. Aspiration of secretion; C. Injection of sustained release hormone; D. Opening eustachian tube under pressure; E. 6 months after operation

5. Discussion

Previous studies have shown that adenoid hypertrophy in children is an important cause of the onset of OME, and the main mechanisms have been described [8,9]: ① it causes mechanical obstruction and dysfunction of the eustachian tube, and the pharyngeal tympanic orifice is squeezed by the proliferating adenoid, which causes negative intratympanic pressure, venous dilatation of the mucous membrane of the middle ear, increased permeability of the tube wall, serum leakage, and formation of tympanic effusion, ②eustachian tube regurgitation, the enlarged adenoids occlude the posterior nares, and the pressure of the nasopharynx increases during swallowing, which causes the reflux of pharyngeal secretions to the eustachian tube into the middle ear; ③the adenoids are a "saving pool" of bacteria; ④ the adenoids are immunologically abnormal, which makes the nasopharynx mucosa susceptible to infection and edema, leading to otitis media with disturbed eustachian tube function. Excision of the proliferating adenoid and preservation of the eustachian pharyngeal orifice and round occiput is therefore a common approach to the treatment of OME with adenoid hypertrophy. In this study, the key factors for the treatment of OME included plasma assisted sub glandular contour resection, excision or remodeling of hypertrophic proliferative or flap shaped lobulated abnormal eustachian tube pharyngeal folds during surgery, attention to the eustachian tube pharyngeal port protection, and prevention of damage caused by dysfunction. Endoscopic isoglandular resection was intuitive and thorough: adenoidal resection with 70 degrees nasal endoscopy was beneficial for intraoperative evaluation of the size, extent and relationship of the surrounding structures, the surgical field was clear and intuitive, avoiding the blind nature of traditional surgery non intuitively operated on, for some glands located at marginal sites, such as the posterior nares, nasal floor, pharyngeal crypts and eustachian tube opening like tissue, which can reach any site above by adjusting the knife head angle under the assistance of endoscopy, to achieve a "contoured" type of complete resection, while low-temperature manipulation does not injure and the nerve and bone tissues of the skull base.

Adenoidectomy can achieve the purpose of etiological treatment by directly removing the cause of mechanical obstruction of the pharyngopharyngeal orifice of the eustachian tube, and removing the inflammatory stimulus of the inflammatory factor of the adenoid on the mucosa of the eustachian tube and middle ear, previous studies have affirmed its efficacy in children with adenoid hypertrophy combined with OME and also believe that adenoidectomy alone has insufficient efficiency in the treatment of OME, such as slow hearing recovery, Tympanostomy tube placement is an effective treatment for OME in children, with ventilation tubes maintaining middle ear air pressure until eustachian tube function returns to normal [10]. However, postoperative clogging and dislodging of the ventilation tube may occur. Complications such as ear discharge, acute suppurative otitis media, granulation of the middle ear, tympanic membrane perforation, and tinnitus were more common after tympanostomy tube placement.

To reduce the complications of tympanostomy tube placement, the method of simultaneous tympanostomy with adenoidectomy was used, and for the tympanostomy procedure we would be 0-degree otoscope assisted, by using a 1-ml syringe with a long 7-gauge needle in the anterior and lower quadrant of the tympanic membrane, and the key is to aspirate the intratympanic secretion by using a fine middle ear aspirator with a pressure reducing hole after puncture, and for some cases with a long duration and secretion. Thick thickness cases require careful repeated aspiration and, when necessary, repeated aspiration of injected drug diluted again to the drum chamber without yellowish fluid, thereby reducing irritation of the middle ear mucosa by inflammatory secretions and obstruction of the eustachian tube by thick secretions. For the use of injectable drugs, because of the short residence time of small molecule hormone drugs such as dexamethasone in the tympanic cavity, we use the slow absorption hormone drug prednisolone acetate injection to try to make the drug in the tympanic cavity and the obstructed eustachian tube for a long time, so as to achieve the purpose of attenuating mucosal inflammatory reactions and relieving eustachian tube obstruction. In addition, the pressurized flush through the eustachian tube is the key, the vast majority of children with the eustachian tube is incomplete obstruction, and it is difficult to achieve the purpose of the patency of the eustachian tube with a single injection of drugs, to pressure through the external ear canal, to let slow-release hormone drugs pass through the

eustachian tube, and to act around the eustachian tube for some time, then it can well solve the problem of incomplete obstruction. To prevent excessive pressure damage to the tympanic membrane, tympanic cavity or even damage to the inner ear when the external auditory canal was pressurized, a self-made band pressure reducing otoscope (see photograph 4) was used intraoperatively, and the pressure threshold was set at about +0.2kPa, and pressure was pressed several times to the patency of the eustachian tube, at which point the audible air flow passed through the eustachian tube sound, and milky white drug bubbles were visible in the nasal cavity. 245 cases of OME, only 8 cases could not be perforated the eustachian tube, and routine tube placement was taken intraoperatively. All patients were followed up for 1 year to observe the postoperative complications and recurrence. In 245 cases of OME, if the air bone conduction difference was less than 10dB, the tympanic membrane ventilation tube was removed. Otherwise, the pure tone hearing threshold was reviewed every month until the air bone conduction difference was less than 10dB, the ventilation tube was removed. In 3 cases, the tube was blocked or removed, and the tube was placed again under basic anesthesia. Otoscopy, pure tone hearing threshold testing, and tympanometry were reviewed at 6 months postoperatively in all children, and they continued to be followed up until 1 year postoperatively to observe postoperative complications and recurrences. In 8 of 245 cases of OME, the tympanic ventilation tube was removed if the air bone conduction difference was<10dB at the 6-month postoperative review, otherwise, pure tone hearing thresholds were continued at the monthly review until the air bone conduction difference was <10dB, and in 3 of these cases, the tube was closed or detubated during the procedure and secondary tube placement was performed under rebased anaesthesia. The non tubulation, primary cure rate was 96.73% (237/245). In summary, through the larger case summary of our group, we tentatively believe that the degree of adenoidal hypertrophy in children has a correlation with the incidence of OME; OME with adenoidal hypertrophy, the vast majority of which are not treated with tube placement, can be cured by plasma assisted adenoidectomy with puncture, drug injection, and pressure flush through the eustachian tube, greatly reducing the complications of tympanostomy tube placement in children.

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7. Disclosure Statement

No potential conflict of interest was reported by the authors.

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