

Role of CO₂ Laser and Microdebrider in the treatment of Juvenile onset recurrent respiratory papillomatosis

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Abstract

Objective: To compare the efficacy of two main treatment modalities of microdebrider and carbon dioxide laser excision for juvenile onset recurrent respiratory papillomatosis.

Method: The retrospective study was conducted in May 2021 at the Combined Military Hospital, Kharian, Pakistan, and comprised data from July 1, 2007, to January 31, 2020, of patients of either gender aged 2-12 years who were treated for juvenile onset recurrent respiratory papillomatosis either with microdebrider excision in group A or carbon dioxide laser excision in group B. Extent and severity of disease was documented as per the Derkay-Coltrera grading system. Data was analysed using SPSS 20.

Results: Of the 39 patients, 23(59%) were girls and 16(41%) were boys. The overall mean age at the time of procedure was 6.62±2.06 years. Group A had 22(56.4%) subjects; 15(68.2%) girls and 7(31.8%) boys, while group B had 17(43.6%) cases; 8(47%) girls and 9(53%) boys. The mean operative time for group A was 40.91±11.50 minutes and for group B it was 60.59±19.51 minutes. Postoperative breathing and oedema status was better for group A ($p<0.05$), while there was no significant difference regarding postoperative pain, residual disease and repeat surgeries ($p>0.05$).

Conclusion: Microdebrider was found to be superior to carbon dioxide laser excision in the treatment of juvenile onset recurrent respiratory papillomatosis.

Keywords: CO₂ laser, Human papilloma virus, Laryngeal papillomatosis, Recurrent respiratory papillomatosis.

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Introduction

Recurrent respiratory papillomatosis (RRP) is a benign condition which can affect any part of the aero-digestive tract, most commonly the larynx. These are benign lesions histologically, but malignant transformation has been observed in 3-7% cases.¹ There is bimodal peak of onset; juvenile onset recurrent respiratory papillomatosis (JORRP) at <12 years of age, and adult onset recurrent respiratory papillomatosis (AORRP) at age between second to fourth decade of life.^{2,3} Its incidence is 4.3 per 1,000 in children and 1.8 per 1,000 in adults.⁴ The aetiology is thought to be related to human papilloma virus (HPV); most commonly types 6 and 11, and less commonly types 16, 18, 31 and 33.⁵ HPV type 11 is commonly associated with aggressive disease in children, and can also involve the lower tracheobronchial tree.⁶ The mode of transmission for juvenile disease is thought to be through contact with the vaginal canal of the mother, but not all children exposed to the virus develop papillomatosis. Usually there is a triad of first-born child, vaginal birth and young mother.⁷⁻⁹ Little is known about the transmission of HPV in adults. The usual

presentation can be dysphonia, hoarseness of voice, shortness of breath or stridor. Diagnosis is done usually on laryngoscopy, but confirmation is done through histopathology. Staging is done with subjective functional assessment and anatomical assessment is done as proposed by the Derkay-Coltrera grading system.^{10,11} Complications include development of pneumonia, failure to thrive and progression of the disease into the tracheobronchial tree.¹² The mainstay of the treatment is surgical removal of the growth either with microdebrider or laser vapourisation. Various medical treatments are available with limited success, and recurrences are fairly common due to adjacent normal-looking mucosa being infected with HPV.¹³

The current study was planned to compare the efficacy of microdebrider and carbon dioxide (CO₂) laser excision, the two main treatment modalities in RRP cases.

Patients and Methods

The retrospective study was conducted in May 2021 at the Combined Military Hospital (CMH), Kharian, Pakistan, and comprised data from July 1, 2007, to January 31, 2020, of patients of either gender aged 2-12 years who were treated for JORRP either with microdebrider excision or CO₂ laser excision. Data of patients with complications and comorbidities was excluded, and so was cases in which

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STAGING ASSESSMENT FOR RECURRENT LARYNGEAL PAPILOMATOSIS

PATIENT INITIALS: _____ DATE OF SURGERY _____ SURGEON _____
 PATIENT ID # _____ INSTITUTION _____

1. How long since the last papilloma surgery? _____ days, _____ weeks, _____ months, _____ years, _____ don't know, _____ this is the child's first surgery

2. Counting today's surgery, how many papilloma surgeries in the past 12 months? _____

3. Describe the patient's voice today:
 normal____(0), abnormal____(1), aphonic____(2)

4. Describe the patient's stridor today:
 absent____(0), present with activity____(1), present at rest____(2)

5. Describe the urgency of today's intervention:
 scheduled____(0), elective____(1), urgent____(2), emergent____(3)

6. Describe today's level of respiratory distress:
 none____(0), mild____(1), Mod____(2), severe____(3), extreme____(4)

Total score for questions 3-6=_____

FOR EACH SITE, SCORE AS: 0= NONE, 1= SURFACE LESION, 2=RAISED LESION, 3=BULKY LESION

LARYNX:

Epiglottis
 Lingual surface _____ Laryngeal surface _____

Aryepiglottic folds: Right _____ Left _____

False vocal cords: Right _____ Left _____

True vocal cords: Right _____ Left _____

Arytenoids: Right _____ Left _____

Anterior commissure _____

Posterior commissure _____

Subglottis _____

TRACHEA:

Upper one-third _____

Middle one-third _____

Lower one-third _____

Bronchi: Right _____ Left _____

Tracheotomy stoma _____

OTHER:

Nose _____

Palate _____

Pharynx _____

Esophagus _____

Lungs _____

Other _____

TOTAL SCORE ALL SITES: _____ TOTAL CLINICAL SCORE: _____

Figure: Derkay Coltrera Grading system for Recurrent Respiratory Papillomatosis.

combined modality or an adjunctive treatment was offered. Data was retrieved after waiver from the institutional ethics review board.

The data was segregated into microdebrider excision group A (Medtronic Xomed Laryngeal Skimmer; 2.9-4mm) and CO₂ laser excision group B (SSI Super Pulse MD40; super pulse mode / ablation mode). Patients were offered the treatment according to their own or their guardians' choice after due counselling and explanation of the procedures. All cases underwent flexible endoscope examination, and findings were confirmed under general anaesthesia with

Table: Inferential analysis of data variables.

Variables	Microdebrider (Group A)	CO ₂ Laser (Group B)	p-value	Inference
Mean Operative time (minutes)	40.91±11.50 minutes	60.59±19.51 minutes	0.001	Significantly less Operative time with Microdebrider
Post-op Pain (24 hours after surgery) [VAS 1-10]	4.50	5.06	0.411	No significant difference between any modality
Post-op oedema (24 hours after surgery)	1.36	1.94	0.012	Significantly less Postoperative oedema with Microdebrider
Flexible Nasoendoscopy [1-3]				
Improvement in voice (after 2 weeks of the procedure) [1-5]	3.64	3.17	0.330	No significant difference between any modality
Breathing difficulty (after 2 weeks of the procedure) [1-5]	1.50	2.11	0.002	Significantly better Breathing with Microdebrider
Residual disease (Flexible Nasoendoscopy after 2 weeks via Derkay-Coltrera Grading system)	9.32	10.11	0.729	No significant difference between any modality.

CO₂: Carbon dioxide; p<0.05 is significant

direct laryngoscope. Extent and severity of disease was documented as per Derkay-Coltrera grading system¹⁰ (Figure). Operative time was documented from the start of the intervention till the end. It did not include time for preparation of operating room (OR) and induction and coming out of anaesthesia. Postoperative pain was assessed after 24 hours on a visual analogue scale (VAS) of 1 to 10, with 1 being the lowest and 10 being the most severe. For young toddlers who could not tell about the pain severity, pain was assessed as per their parent's perception. Post-operative swelling of the laryngeal apparatus was assessed through flexible endoscope after 24 hours and graded as 1=mild limited to glottis, 2=moderate involving supra-glottis or subglottis in addition to glottis, and 3=severe involving arytenoids in addition to area of grades 1 and 2. After 2 weeks, all patients were assessed for improvement in voice quality, breathing difficulty and residual disease. Voice improvement score was graded as 1=no voice, 2=mild improvement, 3=understandable but hoarse, 4=near normal but with mild hoarseness, and 5=normal voice. Postoperative respiratory distress was assessed as 1=normal breathing, 2=breathlessness on moderate exertion, 3=breathlessness on mild exertion, 4=breathlessness at rest without stridor, and 5= stridor at rest. Residual disease was assessed in terms of endoscopic findings after 2 weeks with Derkay-Coltrera grading system.¹⁰

Data was analysed using SPSS 20. Data was expressed as frequencies and percentages, and mean and standard deviations, as appropriate. Data normality was checked with Shapiro-wilk test. Independent sample t-test was applied for normal data, while Mann-Whitney test was used for abnormally distributed data. P<0.05 was taken as marker of statistical significance.

Results

Of the 39 patients, 23(59%) were girls and 16(41%) were boys. The overall mean age at the time of procedure was

6.62±2.06 years. Group A had 22(56.4%) subjects; 15(68.2%) girls and 7(31.8%) boys, while group B had 17(43.6%) cases; 8(47%) girls and 9(53%) boys. There were 3(7.7%) cases with laryngeal webs who had previously been operated upon at other hospitals. Besides, 24(61.50%) of the cases were repeat procedures.

The mean operative time for group A was 40.91±11.50 minutes and for group B it was 60.59±19.51 minutes. Postoperative breathing and oedema status was better for group A ($p<0.05$), while there was no significant difference regarding postoperative pain, residual disease and repeat surgeries ($p>0.05$) (Table).

Cases of repeat surgeries in group A were 14(63.6%) compared to B 10(58.8%) in group B. No complications were reported.

Discussion

The use of lasers in otolaryngological practice is very common, especially in JORRP cases. However, since the introduction of specialised laryngeal blades and angled microdebriders, the use of lasers for respiratory papillomatosis is decreasing. In a survey, British paediatric otolaryngologist preferred microdebriders over lasers. Lasers and microdebriders are both efficient techniques for respiratory papillomatosis to the extent that cold steel excision of laryngeal papillomatosis is seldom performed these days.¹⁴ In the current study, microdebrider was found to be superior in some aspects, although it was equal to but not less than CO₂ lasers in many other aspects. Certain disadvantages are associated with CO₂ lasers. Airway fires (laser plumes) have been reported, and to prevent them special endotracheal tubes with aluminium foiling are used. Areas of vaporisation are surrounded by areas of necrosis which create a niche for infections. Further, the cost of instruments, skilled nurse availability and increased operative time are few of its shortcomings. The newer technique utilising microdebriders overcomes many of these disadvantages as they have shorter operative time, there is no risk of airway fire, and the learning curve for microdebriders is small.^{7,15,16}

In the current study, 24(61.50%) of the cases were repeat procedures.

According to a study, the operative time for microdebrider is shorter than laser use primarily because the mode of action of lasers is focussed vaporisation of a small chunk of tissue at a time, and the preparation time to set up the instruments in laser is more than that of microdebriders.⁷ Although the current study did not include OR preparation time in data, the findings are in line with the earlier study.⁷ Another study theorised that the difference would ultimately translate into reduced cost of the procedure.¹⁷

The current findings were similar to those reported by Patel et al.¹⁸

In terms of patient satisfaction, the use of microdebriders produced favourable results in the current study. To our knowledge, no other study has compared these variables with the modality of treatment being offered.

The evaluation of postoperative pain and improvement in voice did not show a significant difference between the groups. A study found no difference in postoperative pain between the groups, but found voice quality to be significantly better in the microdebrider group.¹⁷ This could be explained by the wider age range in that study (2.5 to 20 years) compared to 2-12 years in the current study. Further, the evaluation of postoperative pain was largely dependent upon the parents who were the respondents when the child was unable to answer due to his/her age. However, a study found less postoperative pain in patients who were offered treatment with microdebriders.¹⁸

The current study assessed residual disease with flexible laryngoscope after 2 weeks of the procedure and found no significant difference between the two groups. The common sites of residual disease were anterior commissure, ventricles and sub-glottis. To our knowledge, no study has compared residual disease extent with the technique of surgery, as the disease is notoriously recurrent. Studies concluded that recurrences were only significantly lower in population treated with HPV quadrivalent vaccine.^{19,20} One study found association of disease severity with recurrences.²¹ Kim et al. found association of specific sites with recurrences.³ There was no difference in recurrences with respect to the surgical technique used in a study.¹

The use of microdebriders among otolaryngologists is increasing due to its ability to remove large tissue chunks with simultaneous suctioning.¹⁴ But access to specific regions, like anterior commissure and vocal folds, via microdebrider is difficult. Lasers are effective in excising sessile masses from anterior commissure and vocal folds.²² When microdebriders are used, haemostasis after excision is done with a haemostatic agent applied topically. When lasers are used, the inherent ability of lasers to secure haemostasis is invaluable. This is one of the reasons why some otolaryngologists combine these techniques to draw effective results.¹⁹

Techniques that are overtly damaging would cause functional problems, and under-treatment would cause disease recurrence. Microdebriders are effective for bulky lesions, regarded as precise instruments that cause minimal damage and preservation of the normal mucosa.¹⁵

The current study has limitations as there was no long-term follow-up. Also, the patients or their parents were not

blinded, and were aware of the nature of treatment. As such, the decision to pick one of the two modalities might have been influenced by factors, like cost, and their responses might have been biased as they knew the details of the technique. Many otolaryngologists believe the combination of one or more modalities are more advantageous compared to one-modality treatment. For simplicity we excluded such cases. Currently, many adjuvant treatments are being explored in the world with limited success.^{13,23,24} These are not routinely offered in this part of the world due to non-availability and their financial costs. Another limitation of the study was the sample which excluded adult-onset disease. However, adult larynges, being larger than juvenile, are expected to accommodate the microdebrider and laser instruments easily.

Conclusion

Microdebriders were found to be effective and precise tools for excision of respiratory papillomatosis. It was found superior to laser excision overall.

Abbreviations

Recurrent respiratory papillomatosis (RRP); Juvenile onset recurrent respiratory papillomatosis (JORRP); Adult-onset recurrent respiratory papillomatosis (AORRP); Human papilloma virus (HPV); Visual analogue scale (VAS).

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