Original article

Study of microbial growth on silicone tubes after transcanalicular laser-assisted dacryocystorhinostomy and correlation with patency

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Abstract

Introduction: Intubation in primary transcanalicular laser assisted dacryocystorhinostomy (TCLADCR) is performed to increase the success rates. However, the associated inflammation and infection can have adverse effects. **Objective**: To study the microbial infection and drug susceptibility of extubated silicone tubes and final anatomical patency in patients undergoing TCLADCR. **Materials and methods**: A non-randomised prospective interventional study was conducted in a tertiary care eye centre. The study included twenty consecutive adult patients with primary nasolacrimal duct obstruction. They underwent TCLADCR with bicanalicular silicone intubation. The stents were removed at 2 months and subjected to culture sensitivity, followed by administration of appropriate antimicrobial agents. Main outcome measures studied were the microbial spectrum on the cultured tubes, their sensitivity profile and its correlation with final anatomical patency. **Results**: A positive culture was obtained in 100% cases, comprising of normal commensals and pathogenic organisms. Of the total 24 isolates, 16 (66.6%) Gram positive bacteria (75% Staphylococcus aureus) and 8 (33.3%) Gram negative bacteria (commonest E.coli) were found, with 4 tubes having more than one isolate. No fungal growth was seen. Ninety percent success rate was achieved at one year following appropriate antimicrobial therapy except in 2 patients with gram negative isolates who had failed to take the prescribed antibiotics following sensitivity reports. There was no correlation between multiple infections and success rate. However, by using the Fisher exact test, a positive correlation was obtained between appropriate antibiotic treatment and the final anatomical patency ($p<0.05$). **Conclusion:** Silicone intubation predisposes to microbial growth, which if neglected, can lead to failure of TCLADCR.

Keywords: dacryocystorhinostomy, silicone tube, laser surgery, transcanalicular

Introduction

The new developments in the field of dacryocystorhinostomy (DCR) focus to decrease the complication rate, avoid cutaneous scars and shorten the procedure time and the recovery time so as to make the procedure possible on an out-patient basis (Malhotra et al, 2003). Much of this has been made possible by the development of the technique of transcanalicular laser DCR (Narioka et al,

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2008). On purpose to increase the success rate of the procedure, the use of silicone tubes in DCR is quite common (Bousch et al, 1994; Rosen et al, 1997), although its beneficial effects have not been proven unequivocally (Smirnov et al, 2008; Saiju et al, 2009; Feng et al, 2011). On the contrary, silicone intubation has its own set of complications, which includes the infective potential of these stents (Smirnov et al, 2008; Saiju et al, 2009; Feng et al, 2011; Allen et al, 1989).

It has been suggested that inflammation and fibrosis are among the most common causes of blockage of the ostium in operated DCR patients, and this may be secondary to coexisting infection in the lumen of the lacrimal system (Walland et al, 1994; Huber-Spitzy et al, 1992). This has led to considerable research on the organisms associated with dacryocystitis (Bharathi et al, 2008). For instance, two recent studies have reported the microbiological spectrum of organisms on extubated silicone tubes and correlated the same with the clinical characteristics and surgical outcomes (Kim et al, 2012; Kamal et al, 2012; Ali et al, 2013). However their samples included both external and endoscopic DCR patients, and primary as well as secondary nasolacrimal duct obstruction (NLDO) or revision surgeries (Kim et al, 2012; Kamal et al, 2012; Ali et al, 2013). Also one of them was a retrospective study, with variable duration of intubation, wherein the pre-tube removal findings were based on patient records (Kim et al, 2012), while the second one was a prospective study (Ali et al, 2013).

We extrapolate the same to our patients undergoing transcanalicular laser-assisted DCR (TCLA-DCR), at a tertiary care centre in Northern India, taking into account the fact that role of infection and inflammation would be expected to be more significant in cases of TCLA-DCR, due to the smaller size of the osteotomy created in these patients, as compared to external DCR (Rosen et al, 1997). Therefore we took up this study to correlate the final anatomical patency with microbial growth, if any, on the silicone tubes removed from patients undergoing TCLA-DCR and the appropriate antibiotic treatment thereof.

Materials and methods

A non-randomised interventional study was conducted at our centre, from March 2011 to May 2012. Twenty eyes of twenty consecutive adult patients with primary NLDO, undergoing TCLA-DCR under local anaesthesia, operated by a single surgeon (RG), were included in the study. An informed consent was obtained from all the patients and the study was approved by the institution's ethics committee, being in accordance with the guidelines of the Declaration of Helsinki. Exclusion criteria included patients with nasal abnormalities, preoperative canalicular stenosis, presence of an encysted mucocoel, immunocompromised patients, patients with diseases like sarcoidosis, Wegener's disease etc and patients with systemic contra-indications to surgery. The study did not include cases of congenital dacryocystitis or previously operated cases. Patients with NLDO secondary to trauma were also excluded.

Preoperatively all patients received topical ofloxacin eye drops (0.3%) and nasal decongestant spray (xylometazoline) qid for 7 days. Pre-operative syringing and probing, as well as a nasal examination was done in all patients to confirm the need for DCR surgery and rule out any contra-indications to an endoscopic procedure. An ostium was created in the lateral nasal wall using a 980 nm wavelength diode laser probe (Appasamy Superdiode, Appasamy Associates, Chennai, Tamil Nadu, India) inserted transcanalicularly and operated at a preset power of 8 Watts in continuous mode. (Figures 1,2) The osteotomy so created was then enlarged using Blakesley's nasal forceps to approximately 8mm X 8mm size, followed by bicanalicular silicon intubation (23 Gauge

bicanalicular silicon intubation sets, Medelec Instruments, Delhi, India).

Postoperatively, all the patients received tablet ciprofloxacin 500 mg bd for one week, tablet ibuprofen 400 mg tds for 3 days, nasal decongestant spray (xylometazoline) tds for 2 weeks and topical antibiotic-steroid preparation (moxifloxacin hydrochloride 0.5% and loteprednol etabunate 0.5%) qid for 6 weeks. All patients underwent lacrimal syringing every 2 weeks, alongside the tubes.

The tubes were removed two months postoperatively, under aseptic conditions, under local anaesthesia. This was done under endoscopic visualisation, after excising the exposed loop between the upper and lower puncta (figure 3), and then the tubes were extracted using sterile forceps, taking care to avoid contact with the walls of the nasal cavity. The tubes were directly inoculated onto Blood Agar, MacConkey's medium and Saboraud Dextrose Agar. (figures 4-6) In the microbiological laboratory, Gram stain preparations were also made for all the samples and the plated samples were incubated. The blood agar plates were incubated at 37^0C for 24 hrs, MacConkey's medium incubated at 37^0C for 24 hrs and Saboraud Dextrose Agar incubated at 25^0C for 72 hrs. Routine lab methodology was used for species identification. In case of positive cultures, the organisms grown were then subjected to drug susceptibility tests, using the Kirby-Bauer disc diffusion method. Antimicrobial agents commonly used in all cases included ofloxacin, roxithromycin, teicoplanin, linezolid, amikacin, gentamycin and levofloxacin, among others.

The patients then received oral and topical antibiotics, based on their respective culture and sensitivity reports, for a period of seven days. The patients were then further followed up monthly, for a period of 10 months. Lacrimal syringing was done at every visit and endoscopic assessment of the ostium size and patency was done at 2 months and 12 months postoperatively. The ostium size was assessed endoscopically at the end of follow up using Schirmer paper strips. The identified organisms were analyzed and correlated to the final patency and the presence of inflammatory signs such as conjunctival injection and pus discharge. Success was defined as anatomic patency at the end of 12 months postoperatively, as defined by syringing and endoscopic assessment. The results were analysed using the Fisher's exact test for statistical significance and p value of less than 0.05 was considered significant.

Results

The average age of the patients was 30.6 years (age range 18 years to 75 years), with a male:female ratio of 1:9, there being 2 males and 18 females. There were no intraoperative complications in any of the patients, all being operated upon by a single experienced surgeon, the duration of surgery varying from 12 to 18 minutes.

A positive culture was obtained in 100% of the cases, comprising of commensals of the nose as well as pathogenic bacteria. No fungal growth was obtained. A total of 24 isolates were obtained from 20 patients, with four patients having mixed infection with more than one organism isolated and cultured. Of the total 24 isolates, 16(66.6%) gram positive, 8(33.3%) gram negative and 0(0%) fungi were found. Hence gram positive bacteria outnumbered the gram negative, with Staphylococcus aureus accounting for 75% of the isolates and Enterococcus making up the remaining 25%. The gram negative bacteria comprised of E.coli 5(62.5%), Enterobacter cloacae 2(25%) and Pseudomonas aeruginosa 1 (12.5%). (Table 1).

Two patients showed inflammatory signs at the time of extubation, with pus discharge and mild conjunctival congestion. After culture report, these were found to be due to Enterobacter cloacae in one and Pseudomonas species in the other.

Two of our patients were final anatomic failures at the end of 12 months. One of these was due to E.coli sensitive only to tigecycline, while the other was due to Enterobacter cloacae, with the patient having excessive conjunctival inflammation and discharge at the time of extubation. Both the patients were non-compliant to treatment. On nasal endoscopic visualisation and passage of a suction cannula, the bony nasal ostium was found to be patent in both these patients, and granulation tissue was present proximal to the osteotomy, in the sac area. One of them underwent a revision surgery and was patent postoperatively. The other was lost to follow-up. Rest of the patients, who were compliant with treatment, were postoperative successes. There were no functional failures. Thus, the overall success rate was 90%.

Four patients had infection with more than one organism. However, we found no correlation between multiple infections and success rate (p=0.37%). (Table 2). Furthermore, no correlation was found between presence of signs of inflammation at the time of extubation and the final patency of the ostium (p=0.19%). (Table 3). A positive correlation with p=0.005(Fisher Exact test) was obtained between the appropriate antibiotic taken and the final anatomical patency. The average size of the ostium in successful cases was approximately 22mm^2, at 12 months, measured using Schirmer paper strips and the formula πab (where 2a and 2b are the 2 principle diameters of the oval shaped osteotomy) (Linberg et al, 1982). (Table 4) Although mucosal adhesions between the lateral nasal wall around the osteotomy site and the middle turbinate were found in three patients, yet these patients were freely patent at final assessment.

Discussion

Inflammation is known to be a major cause of nasolacrimal obstruction. Although, silicone tubes are considered to be relatively inert materials, a prolonged duration of the tube placement may lead to inflammation and formation of granulation tissue (Allen et al, 1989). In the study by Kim et al (2012), 8 patients (20.5%) showed inflammatory reaction around the tube at the time of extubation, vis a vis 2 (10%) of ours. This could be due to the regular lacrimal syringing performed by us in our intubated patients, in order to dislodge any collection of inflammatory material around the tube. Frequent syringing may also dislodge the microbes growing at the osteotomy site, thereby affecting our final cultures. However the main aim of DCR surgery is to maintain a patent osteotomy and alleviate the patients' epiphora. Hence, this was a necessary compromise. On the other hand, Ali et al's (2013) study did not report the presence of clinical signs of inflammation or infection in any of their patients. This may be related to the fact that majority of their patients underwent external DCR (84%) which usually has a relatively larger osteotomy size, and hence lesser risk of stasis of secretions etc. However their study does not comment upon the osteotomy size among their patients.

Inflammation and fibrosis may also be secondary to coexisting infectious colonization within the lumen of the lacrimal system (Huber-Spitzy et al, 1992). In a study conducted by Coden et al (1993), culture of lacrimal sac contents or lacrimal sac biopsy revealed positive culture results in 52.5% cases in external DCR. In a recent prospective interventional case series (Ali et al, 2013), culture of silicone stents retrieved from patients of external or endoscopic DCR, at 3 months post-operatively, revealed positive cultures in 94% patients, with 88% showing positive bacterial cultures and 60% fungal cultures. Another retrospective observational case series (Kim et al, 2012), where 39 tubes removed from external and endoscopic DCR patients were cultured, positive culture was obtained in 94.9% cases. A total of 52 isolates

were identified: 73.1% gram positive bacteria, 23.1% gram negative bacteria and 3.8% fungi. In our series, we had positive culture in 100% of cases, of which, 66.6% were gram positive bacteria and 33.3% were gram negative bacteria. There were no fungal isolates.

Staphylococcus aureus was isolated in 75% of the total gram-positive isolates in our cases as compared to 73.9% in the study by Kim et al (2012), but none were MRSA. Ali et al (2013) reported an 18% isolation rate for Staphylococcus aureus among all bacterial isolates, gram negative bacteria being isolated more frequently in their patients. However Staphylococcus is a common nasal commensal, and is also frequently associated with indwelling catheters due to the production of extracellular substances like biofilms (Kim et al, 2012; Coden et al, 1993). Hence, simply its presence is of no significance, unless a definite pathogenicity is proven. Other normal commensals reported in the nasal cavity and the conjuctiva include Streptococci, diptheroid bacilli, Neisseria and Haemophilus. Occasionally, Acinetobacter, Moraxella and Kingella have also been reported. (Smith, 1954; Fernández, 2004; Gordts et al, 2000).

Pseudomonas was isolated only in one patient of ours vis a vis 5 isolates in the study by Kim et al (2012). Also, this could not be correlated to prolonged intubation or surgical failure, as suggested by Kim et al (2012), since all our patients were extubated at 2 months and only primary cases were included in our study. The patient in whom Pseudomonas was isolated was patent at the end of the study period. This is compared against 12 isolates of Pseudomonas reported by Ali et al (2013), which may be due to the fact that they included secondary NLDO and revision surgeries in their study. They also do not report any relation of these culture findings to duration of stent placement or failure of the surgery.

Furthermore, Ali et al (2013) reported a very high rate of Fungal isolation (60%) Vs 3.8% in another study and 0% in ours. They have attributed their findings to the environmental fungi that gain easy access to the nasal cavity through the inhaled air, being more prevalent in a tropical region like Southern India. Absence of fungi among our cultures may be explained by the more extreme weather conditions and lesser humidity in Northern India, making the environment less conducive for fungal growth.

Prophylactic antibiotics are known to prevent infection and are associated with a greater success rate of surgery (Huber-Spitzy et al, 1992). Hence these were prescribed in our patients also. However it is highly unlikely that they influenced the final culture results since they were prescribed in the immediate postoperative week and the silicone tubes were removed at 2 months.

Our study also had a few limitations, first being the possible contamination of the tubes by normal nasal commensals, due to contact with the nasal wall or septum at the time of removal. Secondly the role of Staphylococcus aureus needs to be further studied. Staphylococcus is a common nasal commensal and hence it may be unadvisable to give antibiotics in patients with Staphylococcal cultures unless a definite pathogenicity is proven. Lastly, this is just a pilot study. Larger randomised control trials are needed to better justify a definite correlation between tube culture, antibiotic treatment and the final patency, to compare the surgical results with and without antibiotic treatment based on tube culture-sensitivity reports. Also a comparison between external and endoscopic techniques of DCR is needed.

In our view, considering the smaller size of osteotomy in cases of TCLA-DCR and the propensity of silicone tubes to cause inflammation and/or infection, intubation

should be performed only if definitely indicated and not in all cases. If intubated, regular syringing and nasal douching is advisable to flush out all the deposits and the patient must be adequately counseled to return for tube removal after a specified period, even if asymptomatic at that time. Surgical field must be inspected at the time of tube removal, and must be appropriately treated if inflammation or discharge is present.

Table 1: Table showing the organisms cultured, sensitivity profile and the treatment prescribed

Organism Cultured	Number	Sensitive antibiotics	Antibiotic prescribed	Outcome
Gram Positive Bacteria	**16**			
Staphylococcus aureus	12	ofloxacin, netilmicin, roxythromycin, teicoplanin,linezolid	ofloxacin oral and topical	Patent
Enterococcus sp†	4	netilmicin, roxythromycin, teicoplanin, linezolid (ps‡: ofloxacin, gentamycin)	oral roxithromycin, topical gentamycin+moxifloxacin	Patent
Gram Negative Bacteria	**8**			
Pseudomonas aeruginosa	1	amikacin, cefotaxime, cefepime, ofloxacin, netilmicin, gentamycin, tobramycin,piperacillin-tazobactum, ticarcillin-clavulonate, levofloxacin, colistin, imipenem, meropenem	oral levofloxacin, topical ofloxacin	Patent
E. Coli	4	amikacin, ampicillin, netilmicin, gentamycin, tobramycin, tigecycline, piperacillin-tazobactum, imipenem, meropenem	oral roxithromycin, topical gentamycin	Patent
E. Coli	1	tigecycline	Patient refused treatment	Not patent
Enterobacter Cloacae	2	amikacin, cefotaxime, cefepime, cefazoline, ciproflox, ofloxacin, netilmicin, gentamycin, tobramycin, tigecycline,piperacillin-tazobactum, levofloxacin, imipenem, meropenem	oral and topical ofloxacin	1 Not Patent 1 Patent

† sp= species ‡ ps= partially sensitive to

Table 2: Table showing correlation between the presence of multiple infection and final patency

Final Outcome	Multiple infections		
	Present	Not present	
Patent	3	15	18
Not patent	1	1	2
	4	16	20

Table 3: Table showing correlation between the presence of inflammation and final patency

	Inflammation		
	Present	**Absent**	
Patent	1	17	18
Blocked	1	1	2
	2	18	

Table 4: Table showing organisms cultured, surgical outcome and final size of the ostium

S. No.	Sex	Organism	Outcome	Size of ostium (mm²)
	Female	Staphylococcus aureus	Patent	24
	Female	Staphylococcus aureus	Patent	25
	Female	Staphylococcus aureus	Patent	24
		Pseudomonas		
	Male	Staphylococcus aureus	Patent	36
		E. coli		
	Female	Staphylococcus aureus	Patent	25
	Female	E. coli	Blocked	Blocked
		Enterococcus		
	Female	Enterococcus	Patent	25
	Female	Staphylococcus aureus	Patent	20
	Female	Staphylococcus aureus	Patent	25
	Female	E. coli	Patent	30
	Female	Staphylococcus aureus	Patent	25
	Female	Enterobacter cloacae	Blocked	Blocked
	Female	E. coli	Patent	16
	Female	Enterobacter cloacae	Patent	20
	Female	Staphylococcus aureus	Patent	20
	Male	Enterococcus	Patent	25
	Female	Staphylococcus aureus	Patent	20
	Female	Staphylococcus aureus	Patent	30
	Female	Enterococcus	Patent	25
		Staphylococcus aureus		
	Female	E. coli	Patent	25

Figure 1: Lazer Machine

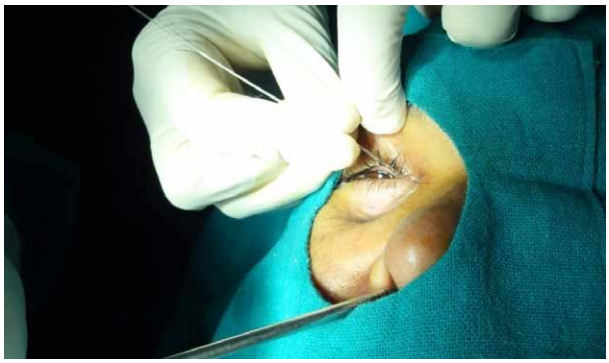

Figure 2: Patient with laser probe and nasal endoscope in situ

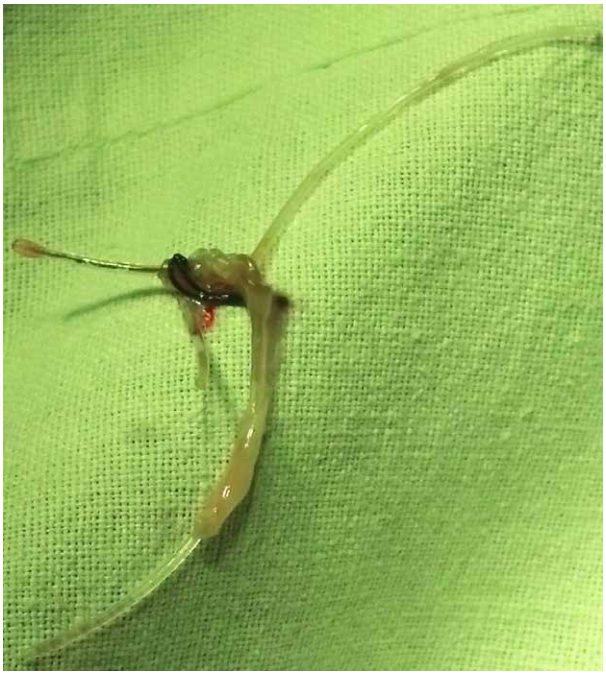

Figure 3: Removed Silicone Tube

Figure 4: Blood Agar Plate

Figure 5: MacConkey's Agar Plate

Figure 6: Sabouraud's Dextrose Agar

Conclusion

In conclusion, silicone intubation predisposes to microbial growth, which if neglected can lead to failure of TCLADCR, and it is recommended that patients should be prescribed appropriate antimicrobial agents following culture and sensitivity report of the tube to achieve better success rates.

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