Congenital nasolacrimal duct (NLD) obstruction is the most common cause of congenital epiphora. It occurs in approximately 6% to 20% of newborns. More than 90% of cases of congenital NLD obstruction resolve spontaneously by 1 year of age. When congenital NLD obstruction does not resolve spontaneously, surgical treatment must be undertaken to relieve the obstruction, and probing is helpful in most patients. If probing is unsuccessful, then intubation with silicone stents is an effective way to relieve the symptoms. In principle, silicone intubation is a simple procedure, and a variety of instruments and modifications of technique have been devised. Even experienced surgeons, however, may encounter difficulties, especially in retrieving metal probes from the nose.

The Ritleng lacrimal intubation system provides a technique for silicone intubation without the need for the retrieving metal probes from the inferior meatus. The technique involves introduction of a Prolene monofilament guide thread, securely fastened to silicone tubing, into a tubular metal probe that opened into the inferior meatus. Success was defined as complete resolution of previous symptoms and a normal result of dye disappearance test in cooperative patients. To establish relationship of success rate with patients’ ages, these data were compared and analyzed.

**RESULTS.** All eyes were successfully intubated with the Ritleng system. The Prolene monofilament spontaneously emerged from the nose in 19 (60%) of 32 eyes, making retrieval simple and uncomplicated. The overall success rate (of all aged groups) was 90%. In the group over 24 months of age, there was no significant decrease in the success rate ($p > 0.1$), but obvious difficulty in intubation and lengthy operation time were noted.

**CONCLUSIONS.** Silicone intubation with the Ritleng system is an effective treatment for patients with congenital nasolacrimal duct obstruction, especially at young age. Comparing with conventional metal probe system, there was minimal nasal bleeding and trauma to the nasal mucosa with Ritleng intubation system. With the advantage of easy retrieval, operation time can be shortened, thereby improving patient care and decreasing potential morbidity.
obstruction were treated by the Ritleng intubation system from June 2001 to November 2002 in Tri-Service General Hospital. The average age of the patients was 20.1 months, ranging from 8 months to 5 years. There were 14 boys and 10 girls. Between the 32 eyes, there were 18 right eyes and 14 left eyes.

The diagnosis of congenital NLD obstruction was established from a complete ophthalmic history of epiphoria and from an ophthalmic evaluation, which showed increase in tear meniscus, reflex of mucopurulence from the NLD and delay in dye disappearance test. All patients had previously undergone unsuccessful medical treatment (lacrimal sac massage and topical antibiotics) or simple lacrimal probing. For patients receiving probing (16 patients, 20 eyes), all were probed 2 times before intubation was performed. Other patients underwent immediate silicone intubations without previous probing due to late initial presentations. The exclusion criteria for this study included a history of trauma, facial surgery, periocular neoplasm and tearing related to eyelid malposition and external eye diseases.

The Ritleng intubation system (model SI-1520, FCI Ophthalmics, Marshfield Hills, MA, U.S.A.) consists of a metal probe (Ritleng probe) with a narrow slit that runs the length of the probe from the funnel-shaped entrance to the outlet opening of inferior end (Fig. 1). The 30-cm1-long silicone tube is smoothly attached to Prolene monofilament at one end. The Prolene monofilament is composed of a thicker dark blue initial portion followed by a thinner light blue portion so that it can be easily removed from the Ritleng probe. The head of the silicone tube is specially designed to be secured in the puncta without intranasal fixation of the tube (Monka tube, Fig. 2).

After informed consent was obtained, all Ritleng intubation procedures were under general anesthesia by the same surgeons (C. H. Chen and P. L. Chen). Detailed operation procedures were described as follows: the inferior meatus was packed with cottonoid strips moistened with 4% cocaine solution. The upper puncta was dilated. The canaliculi were probed with Bowman 00 and 0 probes to ensure adequate size of the common canaliculus. A Ritleng probe was then passed from upper canaliculus into the lacrimal duct through the membranous obstruction. The Prolene monofilament leader was threaded through the probe. As the Prolene monofilament exited the probe tip into the nasal cavity, it often curled in the nasal cavity and spontaneously emerged from the nose. If the Prolene monofilament could not be visualized and grasped with forceps, it could be removed with a hook (muscle hook or Ritleng hook). Once the Prolene monofilament was removed from the nose, the Ritleng probe was withdrawn from the nasolacrimal system. The Prolene monofilament was separated from the intubation set by sliding the thinner portion out through the slit of the probe. The Prolene monofilament was pulled out from the nose, drawing the silicone tube into the NLD. Finally, the head of the silicone tube was fixed.
in the punctum by using the inserter.
Postoperatively, antibiotic ophthalmic drops were used 4 times a day for approximately 2 weeks. Patients were asked to minimize rubbing the eye, although it was a difficult task with small children. In this study, criteria for success were defined as complete resolution of previous symptoms and a normal result of dye disappearance test where applicable within 1 week after operation and after stent removal. Patients’ ages were analyzed to see if these would influence the success rate and the intubation time. ANOVA test was used to assess the difference. A p value of less than 0.05 was considered significant.

RESULTS
All of the 32 eyes (24 patients) in this study were successfully intubated with the Retling intubation system. During operation, the Prolene monofilament spontaneously emerged from the nose in 19 (60%) of 32 eyes. When the Prolene monofilament did not spontaneously emerge from the nose, retrieval was accomplished by using hook beneath the inferior turbinate (6 eyes, 19%) or by using forceps under direct visualization of the inferior meatus (5 eyes, 15%). The Prolene monofilament was removed by using endonasal forceps under endoscopic visualization in 2 eyes (6%), because of serious deformity of nasal turbinate.

Twenty-four patients were divided into 4 groups based on age at the time of intubation: 7-12 months, 13-18 months, 19-24 months, and over 24 months. These age intervals matched other published series and provided similar comparisons. The number of eyes treated in each age group and the success rates are shown in Table 1. Although there was no significant decrease in the success rate, in the group over 24 months of age apparent difficulty in intubation and prolonged operation time were noted (Table 1). Ten eyes in this group had a success rate of 80%. The overall success rate of initial silicone intubation relieving symptoms of NLD with Retleng system was 90% (29/32). In the bilateral obstruction cases, there was no discrepancy in the success rate compared to unilateral cases. There were also no differences in the success rates between left and right eyes.

Planned stent removal was performed 5 to 6 months after surgery in 30 of 32 eyes. Expulsion of silicone tube (Monoka) requiring unplanned surgical stent removal occurred 1 week after surgery in two of 32 eyes. In these 2 patients, the stents were unintentionally dislodged by themselves during sleep or during daily activities. Both cases of persistence of epiphoria necessitated another Retleng intubation; NLD obstruction eventually resolved in these patients after planned stent removal. There were no intraoperative complications in this study. No ophthalmic injuries occurred from planned and unplanned stent removal in the outpatient office. No complications associated with the Monka tube, such as punctal erosion, granuloma formation, or corneal erosion occurred.

DISCUSSIONS
Congenital obstruction of the distal end of the NLD is caused by a thin, persistent mucosal membrane (Hasner membrane). The initial therapy in these patients consists of a conservative regimen of topical antibiotics coupled with external finger massage. If congenital obstruction persists, lacrimal probing of the NLD is generally successful. However, if simple probing is unsuccessful, silicon intubation is an effective treatment for relieving the symptoms of congenital NLD obstruction. Silicone intubation system is thought to

Table 1. Number of eyes treated, and success rates and intubation time for use of Ritleng intubation in congenital nasolacrimal duct obstruction

<table>
<thead>
<tr>
<th>Age</th>
<th>Number of eyes</th>
<th>Success rate</th>
<th>Mean intubation time</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-12 months</td>
<td>4</td>
<td>100%</td>
<td>20.6 minutes</td>
</tr>
<tr>
<td>13-18 months</td>
<td>8</td>
<td>100%</td>
<td>18.6 minutes</td>
</tr>
<tr>
<td>19-24 months</td>
<td>10</td>
<td>90%</td>
<td>18.5 minutes</td>
</tr>
<tr>
<td>&gt; 24 months</td>
<td>10</td>
<td>80%</td>
<td>46.7 minutes*</td>
</tr>
</tbody>
</table>

*p < 0.05.
produce NLD patency by maintaining an opening as the edges of the membranous obstruction heal around the stent.7,8 Silicone intubation generally avoids the need for dacryocystorhinostomy (DCR), a more invasive operation, in infants and young children. The success rate reported for silicone intubation ranges from 60% to 95%.17,18 Our success rate (90%) in this study is comparable to those of previously reported results.

A variety of silicone intubation sets have been described, generally consisting of a silicone tube bounded or glued to a rigid metal probe.9,10 The main difficulty with traditional rigid metal probes is retrieval of the probes from the inferior meatus. The inferior meatus is the space below the level of the ostium of the NLD that separates the lateral nasal wall from the inferior turbinate. The inferior meatus is narrow and obliquely angled. The straight metal probe emerging from the nose will tend to press against the mucosa of the lateral wall and may produce a false passage beneath the mucosa. Besides, attempts to grasp the probe may be difficult, resulting in trauma to the mucosa, bleeding, and lengthy surgery. The Prolene monofilament introduced by the Ritleng system has the advantage of being soft, atraumatic, and easy to retrieve from the nose. Indeed, the Prolene monofilament spontaneously emerged from the nose in more than half of patients (60%) in our study. Only 2 patients required an ENT specialist to remove Prolene monofilament on account of serious deformity of the inferior turbinate.

In most children, intubation is delayed until over 12 months of age, giving them the benefit of receiving trials of conservative treatment and reducing the risk of general anesthesia. But some surgeons advocate that early intubation is associated with a better success rate.14,19 Welsh and Katowitz20 reported a 100% success rate in children intubated before 13 months of age. The success rate decreased with age. Hence, they suggest an optimal age for intubation was before 18 months.

In our study, children over 2 years of age had the lowest success rate off all age groups. Due to small number of enrolled cases, there was not a statistical significance But obvious difficulty in intubation, passing the Prolene monofilament and lengthy operation time were noted. The reasons may be mainly due to persistent obstruction of tear drainage with consequent infection and inflammation leading to scarring that progressively reduces the probability of successful intubation. In all failed cases, during intubation, we encountered difficulty passing the Prolene monofilament through the probe and tight sensation when pulling Prolene monofilament from the nose. After unsuccessful outcomes, dacrocystography was done; then, the severe constriction of NLD was noted in all failed cases. Those might prevent the Ritleng intubation from relieving the symptoms. After that, all 3 eyes were converted to receive DCR operation and better results were gotten.

On account of special design of the monocanalicular tube, the intact punctum sphincter was important. Without intranasal fixation, the monocanalicular tube would be displaced if the sphincter were damaged. Suitable diameter of monocanalicular tube head and insertion in the upper punctum would reduce the displacement rate and foreign body sensation. Additionally, patients’ cooperation of minimize rubbing the eye also is important for a well-positioned tube. There were 2 children in our study who suffered from tube expulsion because of rubbing the eyes. But after good education of patients and their parents, the symptom of epiphoria was relieved by reintubation with Ritleng system.

Our results showed that monocanalicular silicone intubation with Ritleng intubation system is an effective treatment for patients with congenital NLD obstruction. We found retrieval of the Prolene monofilament to be easy, even for inexperienced surgeons. There is minimal nasal bleeding and trauma to the nasal mucosa. Operation time can be kept short, thereby improving patient care, reducing cost, and decreasing potential morbidity. Further follow-up will be helpful in evaluating the long-term outcome of the Ritleng intubation system in patients with congenital NLD obstruction.

REFERENCES

3. Robb RM. Treatment of congenital nasolacrimal system ob-