Anesthesia management in patients with choanal atresia

Ömer Faruk Boran, MD^a, and Selman Sarica, MD^b

^aDepartment of Anesthesiology and Reanimation, School of Medicine, Kahramanmaraş Sütçü İmam Üniversitesi, Kahramanmaraş, Turkey;

^bDepartment of Otorhinolaryngology, School of Medicine, Kahramanmaraş Sütçü İmam Üniversitesi, Kahramanmaraş, Turkey

ABSTRACT

In this retrospective study, we reviewed the anesthesia management of patients with choanal atresia (CA). Fourteen patients undergoing surgery for CA between June 2007 and September 2018 were evaluated for age, gender, CA side, complications, American Society of Anesthesiologists score, duration of anesthesia, and presence of any additional anomalies. Six patients (42%) had bilateral atresia, and 8 (58%) had unilateral atresia. Various congenital anomalies were present in 50% of patients with bilateral atresia. Three patients were intubated with a C-MAC D pediatric blade because their Cormack-Lehane grade was 3 or 4. Though sevoflurane was used for all patients, total intravenous anesthesia was used for two patients with unilateral atresia. All patients were followed postoperatively while intubated except one patient with bilateral atresia. There was no need for postoperative intubation of any patients with unilateral atresia. In conclusion, clinicians should be aware of perioperative and postoperative complications in patients with CA, bilateral atresia, and accompanying congenital anomalies in the neonatal period. Total intravenous anesthesia can be chosen instead of inhalation anesthesia in appropriate cases, but sevoflurane can be used safely in the induction of anesthesia.

KEYWORDS Anesthesia; choanal atresia; intensive care unit; intraoperative care; intubation

Choanal atresia (CA), first described by Johann Roderer in 1755 and seen in every 5000 to 8000 births, is the total obstruction of the posterior choana, unilaterally or bilaterally, which provides clearance between the nose and the nasopharynx.¹ When treatment approaches are assessed, patients with bilateral CA are treated surgically during the first few days of life. The operation for patients with unilateral CA might be delayed until school age.^{2,3} In the literature, the disease has been evaluated in terms of etiopathogenesis,⁴ surgical treatment approaches,^{5,6} and accompanying diseases.⁷ However, few articles have evaluated anesthesia management of patients with special features like CA.² CA is a special case for anesthesia management because special equipment and experience are required to provide airway safety and most patients are newborns requiring urgent operations. The anesthesia team has to consider accompanying anomalies and take precautions for difficult airways.² Sharing anesthetic approaches in rare cases may be useful in reducing complications.

METHODS

Approval for this retrospective study was granted by the local ethics committee. Seventeen patients who were monitored and treated for CA at our clinic between September 2007 and September 2018 were investigated retrospectively. The data were obtained from patient files, computer surgical records, and anesthesia forms. Three patients with missing information were excluded from the study, leaving 14 patients with sufficient data for analysis. The patients were evaluated for age, gender, CA side, complications, American Society of Anesthesiologists scores, duration of anesthesia, the presence of any additional anomalies, laboratory results, and radiology results (*Figure 1*).

The duration of anesthesia was defined as the number of minutes from the beginning of induction to the time the patient was awakened, and the duration of the operation was defined as the number of minutes from the beginning of the procedure to the end of the procedure.

SPSS 17.0 (SPSS Inc, Chicago, IL) was used for analysis. Quantitative data are expressed as mean $\pm$ SD and median

Corresponding author: Ömer Faruk Boran, MD, Department of Anesthesiology and Reanimation, Sütçü İmam University School of Medicine, Kahramanmaraş, Turkey (e-mail: ofboran@ksu.edu.tr)

Received December 7, 2018; Revised January 16, 2019; Accepted January 17, 2019.

range (maximum-minimum) values. Categorical data are expressed as number and percentage. Data distribution was examined with the Kolmogorov Smirnov test. Quantitative data were analyzed using the independent *t* test and Mann-Whitney U test.

RESULTS

Of the 14 patients treated for CA, 6 were male and 8 were female. Their mean age was 9.52 ± 16.11 years (*Tables 1 and 2*). Each patient was evaluated as unilateral or bilateral and is presented separately in terms of anesthesia management. The first patient had CHARGE syndrome, with accompanying coloboma (C), heart defects (H), coagulant atresia (A), growth retardation (R), genital hypoplasia (G), and ear anomalies (E). The second patient had both an atrial septal defect and a ventricular septal defect. The eighth patient had aortic aneurysm, microcephaly, intrauterine corpus callosum, and membranous anal atresia.

Two newborn patients with bilateral atresia came to the operation room intubated. One of these patients, a 2-month-

old, had had two CA operations in another hospital. Intubation tubes were checked. After giving atropine intravenously, a 20 mcg/kg anesthesia induction was given with 6% sevoflurane in 2 L/2 L of O₂/air concentration, and then dexamethasone 0.25 mg/kg, fentanyl 2 mcg/kg, and rocuronium bromide 0.6 mg/kg were given. Induction anesthesia for three patients with bilateral atresia used 6% to 8% sevoflurane inhalation agent after giving intravenous atropine 20 mcg/kg, and then fentanyl 2 mcg/kg and rocuronium bromide 0.6 mg/kg were administered. These patients were intubated using a C-MAC D pediatric blade because they were Cormack-Lehane Grade 3 to 4. The other patient with bilateral CA was intubated successfully with a Macintosh No. 1 blade after induction.

Paracetamol 5 mg/kg intravenous was given to patients who were >2 months old. Only one patient was extubated before being sent to the intensive care unit (a 6-day-old girl with isolated bilateral atresia), and the other five patients were transferred to the intensive care unit while intubated. For unilateral CA patients, the youngest patient was 2 years old with additional anomalies. Dexamethasone 0.25 mg/kg was given intravenously for premedication. For anesthesia induction, 2 mg/kg propofol, 1 to 2 mcg/kg fentanyl, and 0.6 m/kg rocuronium were given. For anesthesia maintenance, five patients were administered 1% to 2% sevoflurane in 1 L/1 L of O₂/air concentration and total intravenous anesthesia (TIVA) was performed with propofol 6 to 12 mg/kg/h and remifentanyl 0.05 to 2 µg/kg/min under bispectral index monitoring for three patients, who were 11, 12, and 14 years old. The patients with 10 mg/kg paracetamol administered intravenously 15 minutes after the operation were transferred to the clinic without any problems.

Figure 1. Noncontrast axial section computed tomography showing left-sided membrano-ossseous choanal atresia.

DISCUSSION

In newborns, the tongue is hard, adhered to the soft palate, located above the soft palate, and bigger when compared to the oropharynx. This anatomic position provides respiratory and swallowing functions at the same time for newborns. Nasal respiration is begun at approximately 4 to 6 weeks of life due to the changes in the oropharyngeal anatomical structure. However, unilateral or bilateral total

Table 1. Characteristics and clinical features of 14 patients receiving anesthesia for choanal atresia

Variables	Mean ± SD or <i>n</i> (%)	Intubation difficulty			Side		
		Positive (<i>n</i> = 3)	Negative (<i>n</i> = 11)	<i>P</i> value	Bilateral (<i>n</i> = 6)	Unilateral (<i>n</i> = 8)	<i>P</i> value
Age (years)	9.52 ± 16.11	0.95 ± 1.98	15.95 ± 19.21	0.084	0.51 ± 0.97	16.27 ± 18.97	0.067
Gender (male/female)	3/11	1/2	2/9	0.725	1/5	2/6	0.615
Side (unilateral/bilateral)	8/6	0/3	8/3	0.063			
Duration of surgery (minutes)	61.85 ± 17.76	78.00 ± 3.57	57.45 ± 17.31	0.070	80.83 ± 5.06	47.62 ± 3.81	0.001
Duration of anesthesia (minutes)	77.57 ± 18.14	93.50 ± 3.70	73.36 ± 18.30	0.097	97.16 ± 5.30	62.87 ± 3.90	0.001

Table 2. Demographic details and clinical characteristics of 14 patients receiving anesthesia for choanal atresia

Patient	Age	Gender	Side	Comorbid diseases	Minutes of anesthesia	Minutes of operation	Anesthesia technique
1	5 days	F	B	CHARGE syndrome	104	78	Inhalation
2	7 days	F	B	ASD, VSD	96	82	Inhalation
3	17 days	F	B		93	78	Inhalation
4	1 month	M	B		102	89	Inhalation
5	2 months	F	B		90	75	Inhalation
6	2 months	F	R		62	48	Inhalation
7	24 months	F	L		64	46	Inhalation
8	30 months	F	B	AA, microcephaly, intrauterine CC, membranous anal atresia	98	84	Inhalation
9	60 months	M	R		93	78	Inhalation
10	11 years	F	R		63	47	TIVA
11	12 years	F	L		67	52	TIVA
12	14 years	E	R		57	42	TIVA
13	28 years	F	L		69	54	TIVA
14	58 years	F	R		59	45	TIVA

AA indicates aortic aneurysm; ASD, atrial septal defect; B, bilateral; CC, corpus callosum; F, female; L, left; M, male; R, right; TIVA, total intravascular anesthesia; VSD, ventricular septal defect.

obstruction of the posterior choana providing clearance between the nose and the nasopharynx may be seen in some cases.⁷ Newborns with bilateral obstruction present with respiratory distress and cyclic cyanosis. In these patients, treatment is usually needed in the first few weeks of life. In rare cases, treated patients with bilateral CA are reported at an older age.^{8,9} Six of our patients had bilateral CA, all of whom were treated within the first 2 months of life. When the disease is unilateral, it may be better tolerated and treatment may be delayed until the preschool period, although cases are usually treated in patients 1 to 2 years old.^{8,9} In our study, two female patients whose ages were 28 and 58 years old were left untreated in the unilateral group. When their anamneses were evaluated, it was found that they lived in rural areas and had both low education levels and low parental education levels; it was thought that the diagnosis of the disease was delayed for these reasons. Consistent with other reports that 60% to 70% of patients have unilateral CA,² 58% of our patients had unilateral CA. Bilateral CA was associated with difficult intubation in our study ($P=0.038$), possibly because of the congenital anomalies that affected many of these patients, most of whom were in the newborn age group.

The main point of our study is to share our experience with anesthesia management in patients with specific features. The indispensable features of anesthesia management are to carefully evaluate patients in the preoperative period

and to predict and prevent possible complications in the intraoperative and postoperative periods. Because 50% of patients may have various anomalies and syndromes, it is necessary to select induction agents and volatile agents appropriate for these additional anomalies and for intubation difficulty.^{2,10}

In our study, 3 of 14 patients had various congenital anomalies accompanying CA. One had aortic aneurysm, microcephaly, intrauterine corpus callosum agenesis, and membranous anal atresia; one had atrial and ventricular septal defects; and one had CHARGE syndrome. We used an inhalation agent as an induction agent in patients with cardiac anomalies. Atropine was given for premedication. We did not notice any problem during the induction of anesthesia. Yildirim et al found that bradycardia occurred after propofol induction, but it was controlled without complications after atropine injection.² In our study, sevoflurane was used for induction in 6 patients with bilateral CA. No complication was seen in the induction period. Sevoflurane is one of the agents with mild effects on mucosal membranes and provides fast and smooth induction of anesthesia due to low blood gas solubility.

Considering the possibility of anomalies associated with airways and the difficulty of newborn intubation, anesthesia induction was provided with sevoflurane/O₂ in patients with bilateral CA who were not intubated.^{2,11} Various types of airways with different sizes should be available in case of

occlusion of nasal passages, which increases the importance of mouth opening. In published case reports of CA, muscle relaxants were suggested to provide airway safety.^{12–14} There were no signs of difficult intubation in patients with bilateral CA. Three patients were Cormack and Lehane grade ≥ 3 after direct laryngoscopy with a Macintosh blade. These patients were intubated using a video laryngoscope pediatric blade at the second attempt. Rida et al indicated that D blade intubation reduced hemodynamic responses to intubation and decreased the need for assisted maneuvers.¹⁵ Other studies have shown that intubation with a video laryngoscope D blade may facilitate intubation in patients with a difficult airway.^{16,17} We also used a video laryngoscope D blade in patients thought to have difficult intubation in the neonatal period. Therefore, we believe that complications that may arise are minimized by using video laryngoscope D blade.

Patients with bilateral CA should be monitored with mechanical ventilator support in the postoperative period and should not be extubated until respiration has completely begun. We extubated a 6-day-old girl with bilateral CA when we believed that her respiration had completely begun. We followed the patient postoperatively while she was extubated in the intensive care unit. Her family was informed about cold air application and stent aspiration. The baby was discharged without complications.

TIVA was performed for three patients with unilateral atresia. Kocaturk et al compared TIVA to inhalation anesthesia in children undergoing dental operations who were 3 to 6 years old. They found that TIVA was associated with lower pediatric anesthesia emergence delirium and higher parental satisfaction.¹⁸ In our study, it seemed that TIVA may be preferred to inhalation anesthesia in children with unilateral CA.

One limitation of our work is the low number of patients. However, we found various problems during anesthesia application similar to those described by previous large studies, and our cases highlight the need for caution, especially for young patients and those with congenital anomalies. Our study was retrospective, which is another limitation, but we did not lose any data because the group of patients had special features and their data were kept up regularly.

In conclusion, clinicians need to be aware of potential perioperative and postoperative complications in patients with CA, especially in those with bilateral CA and in those with accompanying congenital anomalies in the neonatal period. TIVA can be used instead of inhalation anesthesia in appropriate cases, but sevoflurane can be used safely in the induction of anesthesia.

1. Gujrathi CS, Daniel SJ, James AL, Forte V. Management of bilateral choanal atresia in the neonate: an institutional review. *Int J Pediatr*

- Otorhinolaryngol.* 2004;68(4):399–407. doi:10.1016/j.ijporl.2003.10.006.
2. Yildirim ZB, Akdağ M, Çelik F, Baysal E. Anesthesia management in patients with choanal atresia. *J Craniofac Surg.* 2016;27(8):1991–1994. doi:10.1097/SCS.0000000000003086.
3. Hengerer AS, Brickman TM, Jeyakumar A. Choanal atresia: embryologic analysis and evolution of treatment, a 30-year experience. *Laryngoscope.* 2008;118(5):862–866. doi:10.1097/MLG.0b013e3181639b91.
4. Zawawi F, McVey MJ, Campisi P. The pathogenesis of choanal atresia. *JAMA Otolaryngol Head Neck Surg.* 2018;144(8):758–759.
5. Tomoum MO, Askar MH, Mandour MF, Amer MA, Saafan ME. Stentless mirrored L-shaped septonasal flap versus stented flapless technique for endoscopic endonasal repair of bilateral congenital choanal atresia: a prospective randomised controlled study. *J Laryngol Otol.* 2018;132(04):329–335. doi:10.1017/S0022215117002614.
6. Elsheikh E, El-Anwar MW, Abdel-Aziz HR. Impact of successful choanal atresia repair on the nasal mucosa: a preliminary study. *Int Arch Otorhinolaryngol.* 2017;21(3):276–280. doi:10.1055/s-0037-1601404.
7. Keller JL, Kacker A. Choanal atresia, CHARGE association, and congenital nasal stenosis. *Otolaryngol Clin North Am.* 2000;33(6):1343–1351. doi:10.1016/S0030-6665(05)70285-1.
8. Verma RK, Lokesh P, Panda NK. Congenital bilateral adult choanal atresia undiagnosed until the second decade: how we did it. *Allergy Rhinol (Providence).* 2016;7(2):82–84. doi:10.2500/ar.2016.7.0155.
9. Tatar EÇ, Ozdek A, Akcan F, Korkmaz H. Bilateral congenital choanal atresia encountered in late adulthood. *J Laryngol Otol.* 2012;126(09):949–951. doi:10.1017/S0022215112001442.
10. Brooks P, Ree R, Rosen D, Ansermino M. Canadian pediatric anesthesiologists prefer inhalational anesthesia to manage difficult airways. *Can J Anaesth.* 2005;52(3):285–290.
11. Kandasamy R, Sivalingam P. Use of sevoflurane in difficult airways. *Acta Anaesthesiol Scand.* 2000;44(5):627–629. doi:10.1034/j.1399-6576.2000.00523.x.
12. Taib BG, Taib AG, Swift AC, van Eeden S. Cleft lip and palate: diagnosis and management. *Br J Hosp Med.* 2015;76(10):584–585. doi:10.12968/hmed.2015.76.10.584.
13. Shaye D, Liu CC, Tollefson TT. Cleft lip and palate: an evidence-based review. *Facial Plast Surg Clin North Am.* 2015;23(3):357–372. doi:10.1016/j.fsc.2015.04.008.
14. Sher AE. Mechanisms of airway obstruction in Robin sequence: implications for treatment. *Cleft Palate Craniofac J.* 1992;29(3):224–231. doi:10.1597/1545-1569_1992_029_0224_moaair_2.3.co_2.
15. Rida HEF, Elkobbia NM, Moustafa MAA, Aboshanab HAN. Endotracheal intubation using direct laryngoscopy with Macintosh blade versus C-MAC videolaryngoscopy (Macintosh blade and D-blade). *Res Opin Anesth Intensive Care.* 2017;4:1–6. doi:10.4103/2356-9115.202697.
16. Mutlak H, Rolle U, Roskopf W, et al. Comparison of the TruView infant EVO2 PCD™ and C-MAC video laryngoscopes with direct Macintosh laryngoscopy for routine tracheal intubation in infants with normal airways. *Clinics (Sao Paulo).* 2014;69(01):23–27. doi:10.6061/clinics/2014(01)04.
17. Hackell RS, Held LD, Stricker PA, Fiadjoe JE. Management of the difficult infant airway with the storz video laryngoscope: a case series. *Anesth Analg.* 2009;109(3):763–766. doi:10.1213/ANE.0b013e3181ad8a05.
18. Kocaturk O, Keles S. Recovery characteristics of total intravenous anesthesia with propofol versus sevoflurane anesthesia: a prospective randomized clinical trial. *JPR.* 2018;11:1289–1295. doi:10.2147/JPR.S164106.