CLINICAL VIGNETTE

Anesthetic Considerations for a Pediatric Patient with Turner Syndrome

Diana T. Phan, MD and Kenneth Liu, MD

Introduction

Turner syndrome (TS) is a common chromosomal abnormality caused by the total or partial absence of an X chromosome (45, X) with a prevalence of approximately 1:2000 female births.[1-3] Clinical presentation may be variable but commonly includes short stature, gonadal failure, and cardiovascular (CV) anomalies.[1-4] This case report illustrates the anesthetic considerations in managing a patient with TS.

Case Report

A 17-month-old girl with a history of TS was scheduled for an elective excision of a tender, slowly growing upper lip mass several millimeters in size. The firm mass appeared pearly with a raised superficial portion. Previously diagnosed with a bicuspid aortic valve, the patient had been evaluated with an echocardiogram within the last year. It re-demonstrated a bicuspid aortic valve with no calcification or functional limitation and no other abnormalities. Other medical history includes right kidney ureteral duplication without hydronephrosis. She also has left hip dysplasia with nighttime use of an orthotic brace.

Physical exam showed the patient at the 50th percentile for weight and 5th percentile for length. Airway exam was unremarkable and she had no webbing of the neck or edema of the extremities. Laboratory analysis was remarkable for a previously elevated TSH with normal free T4 level, with normal repeated labs just before the procedure. The AST and ALT levels were also minimally elevated at 52 U/L and 54 U/L.

On the day of the procedure, the patient presented with a blood pressure of 116/77. She was given oral midazolam as an anxiolytic prior to surgery. In the operating room, mask induction with sevoflurane was supplemented with intravenous fentanyl and propofol prior to an uneventful endotracheal intubation. Removal of the subcutaneous lip lesion lasted 50 minutes throughout which her vital signs were normal for age. After a smooth emergence and extubation, the patient was discharged home from the recovery room after 45 minutes of monitoring. Final pathology of the removed specimen confirmed a pilomatrixoma.

Discussion

Turner Syndrome (TS) is a common genetic disorder that is often associated with higher morbidity and mortality compared to the general population. TS females have a mortality rate 3 times higher than the general female population.[1,2] A large retrospective study of 800 TS patients, reported cardiac defects, the most common congenital abnormalities at 25% followed by ENTs 22%, dermatologic 21% and urologic 16% findings, with a diverse spectrum.[5] It is important for anesthesiologists to be aware of the many sequelae of TS to better manage patients in the perioperative period.

Cardiovascular

The prevalence of CV disease in TS has been reported as high as 50% and is a major contributor to early death.[1,2] Like in our patient, bicuspid aortic valves can be seen in about 30% of TS patients and are mostly asymptomatic. However, early diagnosis is important to prevent serious complications such as infective endocarditis, aortic aneurysms, aortic dissection, and aortic dilatation.[1] Coarctation of the aorta, often diagnosed in infancy, is reported in 12% of TS patients and can lead to HTN, heart failure, and aortic dissection. Aortic dissection in TS patients occur at an earlier age than in the general population (35 vs. 50-80 years).[1] Cardiac conduction defects are common in TS and are due to myocardial ischemia/infarction and congenital malformations. HTN can present at any age with possible etiologies including cardiac and renal disease or sympathetic nervous system overactivation.[1] It is recommended that all patients at time of TS diagnosis undergo a complete evaluation including exam, blood pressure measurement, ECG, and echocardiography. Echocardiograms should be repeated every 5 years, or more often if structural defects are identified.[2] Cardiac magnetic resonance angiography is recommended at age 12 or sooner if clinically indicated to monitor aortic anomalies.[1,6]

Airway

Characteristic of TS is a short, webbed neck caused by cervical vertebral hypoplasia and fetal lymphedema. This can be seen in 20% of patients and can severely limit cervical mobility during airway manipulation. TS patients can also have prognathism or micrognathia which adds to a difficult airway.[6,7] Several case reports noted a shorter trachea length in adults with TS (13 vs. 20-22 cm) with higher location of the bifurcation which increases risks of accidental extubations and bronchial intubations.[4,8] It is prudent to be prepared for a difficult intubation with a backup plan that includes advanced airway

equipment and surgical staff capable of performing an emergency surgical airway.

Renal

Several studies report an increased incidence of renal and urologic anomalies in TS (11-25%). Commonly seen are horseshoe kidneys, single kidney, malrotation, and duplex collecting system. Long-term follow-up showed that 40% of these patients developed complications including renal parenchymal damage, HTN, recurrent hematuria or UTI, and rarely chronic kidney disease.[2,9] Extra caution should be taken to renally dose medications in TS patients. Once an anomaly is detected, close follow-up is recommended.

Hepatic

Abnormal liver function tests are frequently seen in TS patients, mostly adults. Common etiologies include hepatic steatosis and steatofibrosis related to obesity, hyperplasia and cirrhosis associated with congenital vascular abnormalities. It is recommended to check liver enzymes annually starting at age 10 for early detection.[2,10]

Endocrine

TS patients have a higher risk of developing diabetes mellitus (DM) for several reasons: growth hormone therapy which increases insulin resistance; early loss of ovarian function; physical inactivity and obesity.[1-3] Risk of diabetes can be 3-5 times higher than in females without TS. Perioperative blood sugar monitoring is important.[2] TS is also commonly associated with short stature however these patients generally do not have growth hormone deficiency. Rather, their bodies do not utilize growth hormones effectively and taking synthetic hormones is often needed to increase growth. Growth velocity declines early between 2-4 years. Without supplementation, TS patients will likely be shorter than the normal population with average height 4'7".[11] Airway equipment, including endotracheal tube, should be carefully sized for each patient.

Autoimmune

The risk of autoimmune disease can be doubled in TS compared to the general population, most commonly thyroid diseases such as Hashimoto's thyroiditis. Other diagnoses include Type I DM and juvenile rheumatoid arthritis.[6,12] Labs and clinical findings should be monitored.

Dermatologic

The most common skin lesions seen in TS are nevi, and less common dermatologic conditions include psoriasis, vitiligo, alopecia, and keloids.[5] Most relevant to our case is the higher prevalence of pilomatricomas in TS. A retrospective study of 311 TS patients, found 2.6% with pilomatricomas which is uncommon in the general population with unknown prevalence.[13]

Psychologic

There is an increased rate of ADHD and developmental delays in kids with TS. In adulthood, anxiety, depression, autism, and executive functioning deficits may manifest. It is recommended that neurodevelopmental evaluations be performed at 12, 24, and 36 months for early detection and initiation of therapies.[3,14]

Conclusion

We reviewed findings associated with TS. However, TS patients can present with a wide range of clinical presentations, making each case a unique challenge for the anesthesiologist. It is crucial for the provider to obtain a comprehensive medical and anesthetic history and perform a thorough exam. The management of TS patients require careful assessment of its risk factors.

REFERENCES

1. **Morgan T**. Turner syndrome: diagnosis and management. *Am Fam Physician*. 2007 Aug 1;76(3):405-10. PMID: 17708142.
2. **Davis SM, Geffner ME**. Cardiometabolic health in Turner syndrome. *Am J Med Genet C Semin Med Genet.* 2019 Mar;181(1):52-58. doi: 10.1002/ajmg.c.31678. Epub 2019 Feb 18. PMID: 30775849; PMCID: PMC7382389.
3. **Davenport ML, Cornea E, Xia K, Crowley JJ, Halvorsen MW, Goldman BD, Reinhartsen D, DeRamus M, Pretzel R, Styner M, Gilmore JH, Hooper SR, Knickmeyer RC**. Altered Brain Structure in Infants with Turner Syndrome. *Cereb Cortex*. 2020 Mar 21;30(2):587-596. doi: 10.1093/cercor/bhz109. PMID: 31216015; PMCID: PMC7444739.
4. **Maranhão MV**. Turner syndrome and anesthesia. *Rev Bras Anestesiol*. 2008 Jan- Feb;58(1):84-9. English, Portuguese. doi: 10.1590/s0034-70942008000100012. PMID: 19378549.
5. **Yeşilkaya E, Bereket A, Darendeliler F, Baş F, Poyrazoğlu Ş, Küçükemre Aydın B, Darcan Ş, Dündar B, Büyükinan M, Kara C, Sarı E, Adal E, Akıncı A, Atabek ME, Demirel F, Çelik N, Özkan B, Özhan B, Orbak Z, Ersoy B, Doğan M, Ataş A, Turan S, Gökşen D, Tarım Ö, Yüksel B, Ercan O, Hatun Ş, Şimşek E, Ökten A, Abacı A, Döneray H, Özbek MN, Keskin M, Önal H, Akyürek N, Bulan K, Tepe D, Emeksiz HC, Demir K, Kızılay D, Topaloğlu AK, Eren E, Özen S, Abalı S, Akın L, Selver Eklioğlu B, Kaba S, Anık A, Baş S, Ünüvar T, Sağlam H, Bolu S, Özgen T, Doğan D, Deniz Çakır E, Şen Y, Andıran N, Çizmecioğlu F, Evliyaoğlu O, Karagüzel G, Pirgon Ö, Çatlı G, Can HD, Gürbüz F, Binay Ç, Baş VN, Fidancı K, Polat A, Gül D, Açıkel C, Demirbilek H, Cinaz P, Bondy C**. Turner syndrome and associated problems in Turkish children: a multicenter study. *J Clin Res Pediatr Endocrinol*. 2015 Mar;7(1):27-36. doi: 10.4274/jcrpe.1771. PMID: 25800473; PMCID: PMC4439889.

6. **McCarthy K, Bondy CA**. Turner syndrome in childhood and adolescence. *Expert Rev Endocrinol Metab*. 2008; 3(6):771-775. doi: 10.1586/17446651.3.6.771. PMID: 19789718; PMCID: PMC2752892.
7. **Mashour GA, Sunder N, Acquadro MA**. Anesthetic management of Turner syndrome: a systematic approach. *J Clin Anesth*. 2005 Mar;17(2):128-30. doi: 10.1016/j.jclinane.2004.06.010. PMID: 15809130.
8. **Divekar VM, Kothari MD, Kamdar BM**. Anaesthesia in Turner's syndrome. *Can Anaesth Soc J*. 1983 Jul;30(4): 417-8. doi: 10.1007/BF03007866. PMID: 6871780.
9. **Lucaccioni L, Wong SC, Strano R, Donaldson M, Cascio S, Mason A**. Associated renal anomalies in children with Turner syndrome: 43-year experience from a single-centre. *Endocrine Abstracts* (2015) **39** OC6.4. Available at: https://www.endocrine-abstracts.org/ea/0039/ea0039oc6.4.htm.
10. **Roulot D**. Liver involvement in Turner syndrome. *Liver Int*. 2013 Jan;33(1):24-30. doi: 10.1111/liv.12007. Epub 2012 Nov 1. PMID: 23121401.
11. "Growth." Turner Syndrome Foundation. Available at: https://turnersyndromefoundation.org/what_is_turner_syndrome/growth/.
12. **De Sanctis V, Khater D**. Autoimmune diseases in Turner syndrome: an overview. *Acta Biomed*. 2019 Sep 6;90(3):341-344. doi: 10.23750/abm.v90i3.8737. PMID: 31580326; PMCID: PMC7233727.
13. **Handler MZ, Derrick KM, Lutz RE, Morrell DS, Davenport ML, Armstrong AW**. Prevalence of pilomatricoma in Turner syndrome: findings from a multicenter study. *JAMA Dermatol*. 2013 May;149(5):559-64. doi: 10.1001/2013.jamadermatol.115. PMID: 23426075.
14. **Hutaff-Lee C, Bennett E, Howell S, Tartaglia N**. Clinical developmental, neuropsychological, and social-emotional features of Turner syndrome. *Am J Med Genet C Semin Med Genet.* 2019 Mar;181(1):126-134. doi: 10.1002/ajmg.c.31687. Epub 2019 Feb 14. PMID: 30767374; PMCID: PMC6487305.