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Performing an urgent neonatal cardiac intervention safely during the COVID-19 pandemic

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ABSTRACT

The current pandemic has driven the medical community to adapt quickly to unprecedented challenges. Among these challenges is the need to minimize staff exposure to COVID-19 during neonatal cardiac procedures. In this report, we describe measures we have taken to protect health care workers while ensuring successful outcomes. These measures include wearing appropriate personal protective equipment, physical distancing, designating separate delivery and transport teams, and limiting the number of providers in direct contact with any patient who is infected or whose infection status is unknown.

Learning objectives:
1. To understand specific challenges caused by the COVID-19 pandemic for patients with congenital heart disease needing urgent neonatal intervention.
2. To recognize measures that can be taken to minimize health care workers’ exposures to the virus during high-risk neonatal cardiac procedures.
3. To review the management of neonates with d-transposition of the great arteries and inadequate mixing.

1. Presentation

Our patient’s mother was a 33-year-old G2P1 with symptoms of dry cough, malaise, and fever that developed approximately 18 days prior to planned full-term delivery. The mother, father, and sibling were diagnosed with COVID-19 shortly before delivery. Prenatal echocardiography at 23 weeks of gestation revealed d-transposition of the great arteries (TGA) with an intact ventricular septum. The atrial septum appeared aneurysmal with high suspicion for the need of an emergent postnatal balloon atrial septostomy (BAS) to enlarge the atrial communication to promote adequate mixing of oxygenated and deoxygenated blood required in this cyanotic lesion. Given the anticipated critical status of a neonate born to a mother with COVID-19, extensive discussions between the care teams and infection control were undertaken to optimize coordination of postnatal care for the optimum clinical outcome as well as protection for health care workers.

2. Management

The mother received standard prenatal care and reported to the...
hospital at 39 weeks of gestation for scheduled labor induction. She received misoprostol and was eventually transitioned to intravenous oxytocin for labor augmentation. As the patient was transitioning to active labor, a category II fetal heart tracing was noted with baseline fetal heart rate of 90–100 bpm and occasional decelerations. Meconium was also noted. As a result, cesarean section was recommended but not pursued at the mother’s request. It was deemed clinically reasonable to monitor progress for possible vaginal delivery. The fetal heart rate was monitored continuously, and the mother had a vaginal delivery approximately 4 h later of a boy weighing 3320 g with Apgar scores of 8 at both 1 and 5 min of life.

Prior to delivery, a negative pressure room was prepared in the infant cardiac care unit (ICCU) with appropriate resuscitation supplies and equipment for a BAS including a balloon catheter and echocardiography machine. Additional safety measures were developed by ICCU leadership to ensure the safety of health care workers involved in the patient’s care:

1. Providers caring for the patient were required to don personal protective equipment (PPE) including gowns, gloves, N95 respirators,

Fig. 1. Schematic depicting the positions of all care providers involved in the balloon atrial septostomy (BAS). Personal protective equipment (PPE).

Fig. 2. Two-dimensional and color Doppler echocardiographic images of the right atrium (RA), left atrium (LA) and atrial septal defect (white arrow). A. The atrial septal defect was small postnatally as indicated by the small jet of color flow (red) noted across the atrial septum (right-hand image). B. After balloon atrial septostomy, the atrial septal defect is moderate in size without restriction of flow across it.
and eye protection (face shield or goggles). Donning and doffing took place in the hallway outside of the patient’s room, and a designated nurse assisted providers with these processes.

2. Providers were directed to maintain at least 6 ft of separation from one another. This physical distancing was self-enforced, with frequent department- and hospital-wide email reminders.

3. Multiple teams were designated for each phase of delivery and transport. Once the patient was born, a delivery team provided resuscitation in the delivery room and transferred the patient directly to a hybrid incubator/radiant warmer bed placed outside the delivery room. A separate transport team ensured appropriate monitoring and transported the patient to the ICCU while the delivery room team appropriately doffed before exiting. Supplemental oxygen was provided via nasal cannula (FiO2 100%) in the closed incubator. The transport team delivered the isolette to the ICCU and transitioned care to the team in the negative pressure room.

4. The number of providers with direct patient contact, including physicians and nurses, was restricted to the minimum necessary. To facilitate this measure, essential personnel who could be inside the patient’s room were identified. The remaining providers observed from outside the patient’s room and were able to communicate with providers inside the room via hospital communication devices (Fig. 1).

Once in the ICCU, the patient was intubated by the neonatology attending physician for hypoxia and to prepare for the eventual BAS. The intubating clinician wore an isolation gown, gloves, protection goggles, and N95 respirator (Kimberly-Clark Tecno Fluidshield PFR95-270, Dallas, TX). Following endotracheal intubation, a prostaglandin infusion was started at 0.01 μg/kg/min to maintain ductal patency. The patient’s pre-ductal saturation was noted to be 65% on 100% FiO2, with a blood pressure of 58/34 mm Hg and a heart rate of 158 bpm. An advanced imaging pediatric cardiologist confirmed the diagnosis of d-TGA and identified a small, restrictive atrial communication with advanced imaging pediatric cardiologist confirmed the diagnosis of d-TGA and identified a small, restrictive atrial communication with advanced imaging pediatric cardiologist confirmed the diagnosis of d-TGA and identified a small, restrictive atrial communication with advanced imaging pediatric cardiologist confirmed the diagnosis of d-TGA and identified a small, restrictive atrial communication with advanced imaging pediatric cardiologist confirmed the diagnosis of d-TGA and identified a small, restrictive atrial communication with advanced imaging pediatric cardiologist confirmed the diagnosis of d-TGA and identified a small, restrictive atrial communication.

Echocardiography was also used to confirm placement of the umbilical venous catheter and to guide the BAS. Imaging for the BAS procedure was undertaken in a standard manner alternating between subcostal long and short axis views to visualize the atrial septum, the position of the wire, and subsequently the inflated balloon. The septostomy was completed successfully by a pediatric interventional cardiologist using a 13.5 mm diameter Z-5™ Atrioseptostomy balloon catheter (B. Braun Interventional Systems Inc., Bethlehem, PA) with 3 pulls to ensure an adequately sized atrial communication (Fig. 2). Post-procedure imaging was performed to assess the cardiac anatomy in further detail. The oxygen saturation improved post-procedure, ranging from 78 to 84%, with a blood pressure of 71/40 mm Hg and a heart rate of 160 bpm. Following the procedure, the echocardiography machine was cleaned using Sani-Cloth AF3 germicidal disposable wipes, and all providers removed PPE in the sequence recommended by the Centers for Disease Control and Prevention.

Parents who have recently tested positive for SARS-CoV-2 are not permitted to enter the ICCU until they are asymptomatic and test negative for the virus. Although the patient himself tested negative for COVID-19 approximately 24 h after birth, we consider any neonate born to a mother with COVID-19 as a “person under investigation” until 14 days of age. As a result, the infant remained on airborne isolation precautions and was tested for the virus several times during his hospital course. His reverse transcription polymerase chain reaction (RT-PCR) tests were negative for SARS-CoV-2 and were negative on day of life 1, 2, 3, and 7. While this testing frequency was part of our hospital’s initial protocol, the protocol has since changed. Patients are now tested exclusively at 24 h after birth and 14 days of age, in addition to testing prior to any procedure.

The patient underwent an uncomplicated arterial switch operation on day of life 4. The surgical and anesthesiology teams donned appropriate PPE during the surgery, including eye protection and N95 respirator. The patient had an uncomplicated postoperative course and was discharged home on day of life 11. All health care workers involved in his care followed institutional safety precautions for COVID-19 throughout his admission. As of day of life 14, the patient remains negative for COVID-19 and all staff involved with the BAS remain clinically asymptomatic.

Our institution instructs health care personnel to self-monitor for symptoms and to stay home if any symptoms arise. Providers are offered virtual visits as well as RT-PCR or serum antibody testing for SARS-CoV-2 as clinically appropriate.

3. Conclusion

BAS can be performed safely and effectively in neonates with complex congenital heart disease born to mothers with COVID-19 when proper precautions are taken by the intensive care, interventional, and imaging staff involved. It is imperative that hospitals provide care for patients in the safest way possible for patients and health care workers during the pandemic. In this report, we have identified measures to help avoid occupational transmission of SARS-CoV-2 during urgent neonatal cardiac interventions. Implementing these and other infection-control measures will help to reduce spread of the virus, keeping our patients and health care workers safe.

Declaration of competing interest

The authors have no conflicts of interest to declare.