

# Anesthesia and potential aerosol generation during magnetic resonance imaging in children with COVID-19

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## 1 | INTRODUCTION

The American College of Radiology recommends minimizing magnetic resonance imaging (MRI) in COVID-19 patients, postponing nonurgent examinations, and using alternative imaging.<sup>1</sup> Sedation/anesthesia are aerosol-generating procedures (AGP) due to the requirement of bag-mask ventilation, intubation, and extubation with consequent risk of exposure to healthcare workers. This is complicated by limitation in the use of personal protective equipment (PPE) in the magnet zone (Zone IV). We describe our experience for children requiring anesthesia for emergency MRI during the COVID-19 outbreak in Philadelphia.

## 2 | METHODS

This study protocol received an exempt from IRB. Between March 26, 2020, and May 11, 2020, we performed chart review to identify children with laboratory diagnosed or probable COVID-19 who underwent MRI that necessitated general anesthesia. Electronic medical record query was performed for all anesthesia procedures, and children who had MR procedures under general anesthesia were identified.

## 3 | RESULTS

A total of 149 MR procedures were performed in the time period. Among this, we identified four children with COVID-19 who underwent emergency MRI that necessitated general anesthesia (Table 1). The care of the COVID-19 patients required multidisciplinary

conversation and planning. For the management, we divided MRI into zones to reduce exposure to healthcare workers (Figure S1) and identified themes and workflow for safe care of COVID-19 patients and healthcare workers during MRI and AGP (Table S1). Team members expected to enter Zone IV removed all ferromagnetic material prior to donning PPE. Metal screening for staff and patient was performed ahead of time. We identified a negative pressure room equipped to provide general anesthesia, used high-quality viral filtration in the breathing circuit, and verified the presence of anesthesia scavenging system to prevent aerosol spread. The transport path for the patient to and from the MR area was clearly defined along with the assistance of hospital security. The PPE used<sup>2</sup> is reported in Table 1.

## 4 | DISCUSSION

Our routine MRI anesthesia management is with natural airway or laryngeal mask airway. There was a change in the technique with COVID-19 patients which included airway management in a negative pressure room and expanded PPE to prevent aerosol generation. Although surgical masks are an MR safe alternative, due to AGP this was considered insufficient. As of writing this report, not all types of respirators are tested in the MR environment. Powered air-purifying respirators (PAPR) are likely not acceptable due to MRI safety concerns. A recent study evaluated the use of European respirators in the MR environment on a three-dimensionally printed phantom face. They found considerable force/torque in the MR environment that could disrupt the tight mask seal during AGP and were regarded as MR unsafe.<sup>3</sup> This study did not evaluate N95 masks, which are a commonly used respirator in the United States. N95 masks consist of a metal nose piece that could pose a hazard in the magnet zone of MRI and may not have been evaluated for MR safety. We checked the interaction of the

TABLE 1 COVID-19, patient demographics, and the use of N95

Case No.	COVID-19 Status	Age/Gender	Gender	Indication for MRI	Type of MRI	Anesthetic technique	PPE used	N95 used in magnet zone
1	Lab confirmed <sup>a</sup>	31 mo	Male	Shoulder abscess	Shoulder; whole body	Intubation and extubation in NP room	Headcover Shoe cover Gown and gloves Eye protection N95 mask	Yes
2	Probable	5 mo	Male	Evaluate cystic structure, history ventriculitis	Brain	Intubation and extubation in NP room	Headcover Shoe cover Gown and gloves Eye protection N95 mask	Yes
3	Probable	24 mo	Female	Abdominal mass	Abdomen and Pelvis	Intubation and extubation in NP room	Headcover Shoe cover Gown and gloves Eye protection N95 mask	Yes
4	Probable	7 y	Female	Status post-lung transplant, liver neoplasm	Brain; Whole body PET MRI	Intubation and extubation in NP room	Headcover Shoe cover Gown and gloves Eye protection N95 mask	Yes

Note: Probable COVID-19 status = resident of endemic area based on our hospital threshold of 6 cases/1000 persons.

Abbreviations: MRI, magnetic resonance imaging; NP, negative pressure; PET, positron emission tomography; PPE, personal protective equipment.

<sup>a</sup>Lab, laboratory using polymerase chain reaction on a nasopharyngeal swab.

N95 respirator (3M, St Paul, Minnesota, USA) metal piece with the magnet by wearing it and moving into an empty MR room. There was a tug felt when the face with N95 on was close to the bore with no difference in “feel” away from the gauss line (away from the bore). Although on the basis of this alone, we cannot say if N95 is protective to the wearer in the magnet zone but the possibility of its use should be considered until further data are available.

#### ETHICAL APPROVAL

.Children's Hospital of Philadelphia IRB#20-017294 Review – Exemption Granted.

#### CONFLICT OF INTEREST

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#### REFERENCES

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2. Meng L, Qiu H, Wan L, et al. Intubation and ventilation amid the COVID-19 outbreak. *Anesthesiology*. 2020;132(6):1317-1332.
3. Murray OM, Bisset JM, Gilligan PJ, Hannan MM, Murray JG. Respirators and surgical facemasks for COVID-19: implications for MRI. *Clin Radiol*. 2020;75(6):405-407.

#### SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.