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LETTER TO THE EDITOR

McGRATH™ MAC size 1 vs. 2 blades: infant intubation time

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To the Editor:

Infants are at higher risk than adults during anesthesia due to their shorter apnea tolerance time [1] and higher rates of respiratory-related adverse events [2]. Therefore, safe induction of anesthesia in infants requires a higher first intubation success rate, and a shorter intubation duration, to minimize apnea time.

The recently available McGRATH™ MAC (Covidien, Medtronic, Tokyo, Japan) size 1 blade for infants is smaller, with an improved body (McGRATH™ MAC AO3) [3, 4]. However, no study has examined the relationship between blade size and time needed for tracheal intubation with this device. This study aimed to compare the time needed for intubation between McGRATH™ MAC size 1 and 2 blades in infants.

This single-center, retrospective, observational study adhered to the tenets of the Declaration of Helsinki. The study was approved by the Ethical Review Committee of Hokkaido University Hospital, Sapporo on April 3, 2023 (IRB No. 023-0004). The opportunity to opt-out of the study was provided through the Hokkaido University Hospital website (https://www.huhp.hokudai.ac.jp/date/rinsho-johokokai/approval/).

The study included patients aged < 1 year who underwent cardiac surgery between January 22, 2019, and December 31, 2022, using McGRATH™ MAC. Data between April 1, 2020 and May 31, 2021, were excluded owing to a shortage of video laryngoscope blades during the coronavirus disease 2019 pandemic. The inclusion criteria were: (1) tracheal intubation in the operating theater, (2) body mass ≥ 3 kg, and (3) a guardian who had no objection to the patient's participation in the research. The exclusion criteria were: (1) intubation without a video laryngoscope and (2) no video recording of tracheal intubation.

All the cases involved rapid induction of anesthesia. Stylets were routinely used in all eligible cases at our institution. The size 2 blade was used until May 31, 2021; this was classified as MAC2, while the size 1 blade was introduced from June 1, 2021; this was classified as MAC1.

The tracheal intubation process was analyzed using video recordings from a monitoring camera in the operating room. The time needed for tracheal intubation was defined as that from the insertion of the laryngocope into the oral cavity to its complete removal, as in our previous report [5]. If multiple tracheal intubations were performed, the time needed for intubation was that of the last tracheal intubation. The time needed for intubation was divided into the time from the initiation of laryngoscope insertion to the beginning of endotracheal tube (ETT) insertion i.e., the glottis visualization time (Time A) and that from the beginning of ETT insertion to withdrawal of the laryngoscope i.e., the tube guidance time (Time B). If the size of the ETT was changed only because the ETT was too large, the next attempt was considered the first-time tracheal intubation. Patients were classified as at risk of difficult intubation if they had any chromosomal abnormalities, conditions and syndromes known to be associated with difficult intubation; previous difficult intubation transitions; and clinically noted complex intubation factors (including small forehead, limited neck retroversion, and limited mouth opening).

The primary objective was to compare the time needed for tracheal intubation between the McGRATH™ MAC size 2 and 1 blades. Since this was a retrospective study, for the feasibility of the study, the sample size was determined as consecutive cases based on the number of patients enrolled and evaluated in our hospital during the study period. To compare the time needed for tracheal intubation between

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the MAC2 and MAC1, the hazard ratios (HRs) with 95% confidence intervals (CIs) were estimated using the Cox proportional hazards model. A lower 95% confidence limit of HRs exceeding 1 was considered statistically significant. Statistical analyses were performed using JMP 16 software (SAS, Cary, NC, USA).

Ninety-four cases met the inclusion criteria. We excluded 26 cases due to a lack of anesthesia records and videos ($n=20$) or the use of direct laryngoscopy ($n=6$). Sixty-eight cases of tracheal intubation were analyzed. Of these, 32 and 36 were classified as MAC2 and MAC1, respectively (Online Resource 1). Regarding patient demographic data, median (interquartile range) weight tended to be smaller in the MAC2 (4.8 [3.6, 6.2]) compared to the MAC1 (5.4 [4.0, 7.0]) group (Online Resource 2).

Figure 1 presents the time needed for final tracheal intubation in each. The median time for tracheal intubation in the MAC2 was 27.0 s, and in the MAC1 23.5 s (HR: 1.79; 95% CI 1.08–2.95). The HR adjusted for the patient mass, career length of the intubation provider, and risk of difficult tracheal intubation was 1.71, with a 95% CI of 1.00, 2.89. The median time of Time A was 12 and 7 s for MAC2 and MAC1, respectively (HR: 2.59; 95% CI 1.52–4.41). The median time of Time B was 14 and 15 s for MAC2 and MAC1, respectively (HR: 0.96; 95% CI 0.57–1.63) (Online Resource 3). There was no difference in the first-time tracheal intubation success rate between the two groups (84.4% vs. 75.0%; OR: 0.62; 95% CI 0.17–2.25). There was no significant difference in the percentage of cases with a difference of more than 10% between the highest transcutaneous oxygen saturation before tracheal intubation and the lowest transcutaneous oxygen saturation up to 1 min after tracheal intubation (34.4% vs. 38.9%; OR: 1.38; 95% CI 0.50–3.84) (Online Resource 4).

To our knowledge, this is the first report examining McGRATH™ MAC blade size in infants. In this study, the glottis visualization time showed the main reduction in the intubation time, with no difference in the tube guidance time. The size 1 blade is slightly less thick and is shorter from the camera to the tip compared to the size 2 blade. We hypothesize that the reduction in epiglottis visualization time is due to the smaller blade size, which allows for easy insertion into the oral cavity and makes the loss of orientation caused by deep insertion of the blade less likely. In Glidescope, Ji-Hye Kwon et al. reported that the time to guide the tube to the glottis was longer with a size 1 blade than with a size 2 blade due to a less adequate field of view [6]. In this study, Time B did not differ between MAC2 and MAC1, indicating that the size 1 blade did not interfere with tube guidance; however, the reason for the different results from those in Glidescope remains unclear. We believe that shorter tracheal intubation time reduces the risk of hypoxia

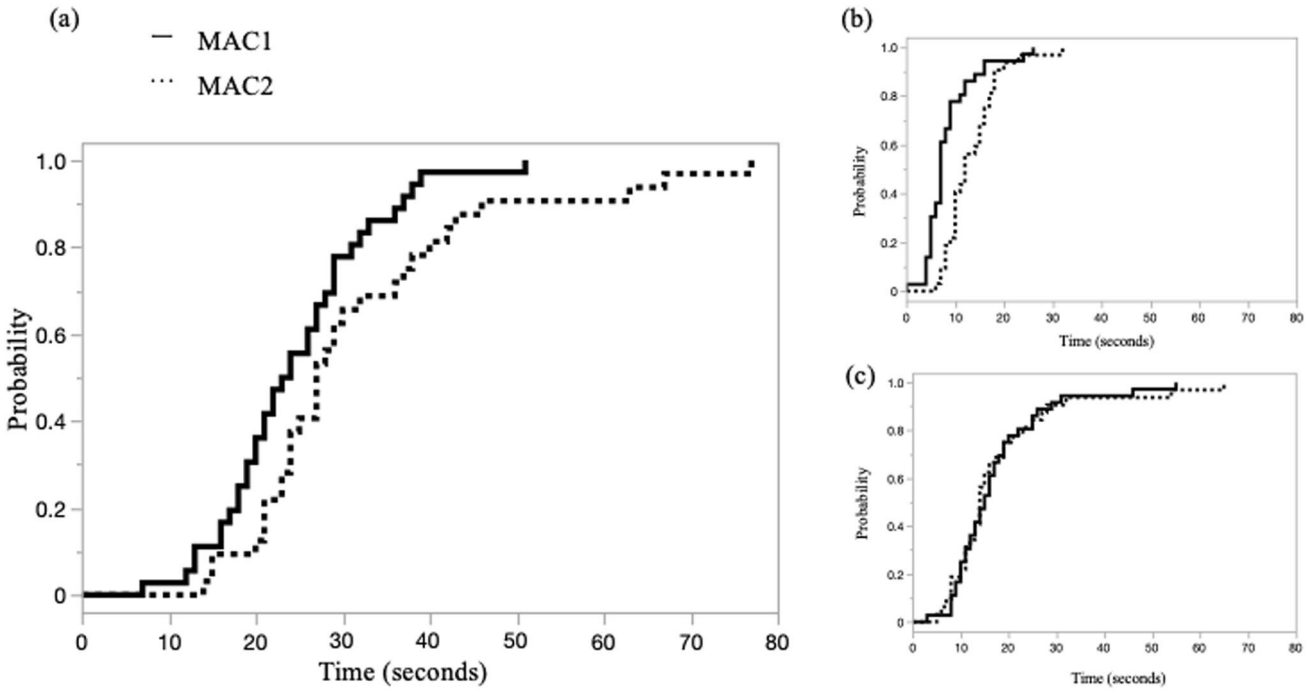

Fig. 1 **a** Time to intubation with the MAC2 and the MAC1 **b** Time to Time A with the MAC2 and the MAC1 **c** Time to Time B with the MAC2 and the MAC1. MAC2, McGRATH™ MAC size 2 blade is used; MAC1, McGRATH™ MAC size 1 blade is used; Time A, time from the start of laryngoscope insertion to the beginning of tube insertion i.e., the glottis visualization time; Time B, time from the beginning of intubation tube insertion to the end of intubation i.e., the tube guidance time

and improves patient safety, under the condition of equivalent fist-time intubation success rates.

This single-center retrospective observational study was limited by the lack of an a priori sample size estimation. Although the sample size was sufficient to detect significant differences in the primary endpoint of tracheal intubation time, it was not large enough to conclusively assess differences in success rates between blade sizes, particularly given the low incidence of intubation failure. Further studies with larger sample sizes are recommended to confirm these findings. In addition, the learning effect may have been affected by the before-and-after comparisons.

This observational study demonstrated that the use of the McGRATH™ MAC size 1 blade during tracheal intubation for cardiac surgery in infants may reduce tracheal intubation time with first-time tracheal intubation success rates comparable to those with the McGRATH™ MAC size 2 blade.

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Data availability The data that support the findings of this study are available from the corresponding author, Yuka Uchinami, upon reasonable request.

Declarations

Conflict of interest Yuka Uchinami, Noriaki Fujita, Kazuyuki Mizunoya, and Yuji Morimoto declare that they have no financial interests relevant to this study. Isao Yokota reports grants from KAKENHI, AMED, and Health, Labour and Welfare Policy Research Grants, Nihon Medi-Physics research fund, and speaker fees from Chugai Pharmaceutical Co, AstraZeneca, and Pfizer, outside the submitted work.

Ethical approval This study was performed in line with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Ethical Review Committee of Hokkaido University Hospital, Sapporo (IRB No.023–0004) on April 3, 2023.

Consent to participate Permission was obtained by the opt-out method. The opportunity to opt-out of the study was provided through the Hokkaido University Hospital website (https://www.huhp.hokudai.ac.jp/date/rinsho-johokokai/approval/) for the guardians/parents of patients who did not wish to participate.

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