

Air-Q ILA as a conduit for orotracheal intubation in children: A randomized control trial for comparison between supine and lateral patient positions

Ravinder K. Pandey, Ankur Sharma¹, Rakesh Garg, Vini Depal, Jyotsna Punj, Darlong V, Renu Sinha, Dalim K. Baidya¹, Rajkumar Subramanian¹

Department of Anaesthesiology, Pain Medicine and Critical Care, All India Institute of Medical Sciences (AIIMS), New Delhi, ¹Department of Anaesthesiology, All India Institute of Medical Sciences (AIIMS), Jodhpur, Rajasthan, India

Abstract

Background and Aims: Airway management in children is always challenging and becomes a concern if required in the lateral position. We evaluated the efficacy of orotracheal intubation using the Air-Q intubating laryngeal Airway (Air-Q ILA) in supine and lateral positions in children.

Material and Methods: This study included 100 children weighing 7–30 kg, scheduled for elective surgeries under general anesthesia. They were randomized into the supine (S) group or lateral (L) group. After anesthesia induction, the child was placed in a standard sniffing position for conventional laryngoscopy in the S group, and the child was turned into the lateral position in the L group. Both Air-Q ILA and endotracheal tube were placed blindly in the supine position in the S group and lateral position in group L. The grading of glottic view, success rate, insertion time of the Air-Q ILA, and endotracheal intubation were noted in both the groups.

Results: The Air-Q ILA was successfully placed at the first attempt in 47 children in group S and 48 in group L. The overall blind orotracheal intubations, including first and second attempts, were successful in 45 children in the S group and 47 in the L group ($P = 0.715$). Eighty percent of patients in group L and 70% in group S had glottis grade 1 or 2 compared to grade 3, 4, 5 ($P = 0.249$). The mean time of Air-Q ILA placement in groups S and L was 15.73 ± 5.64 s and 14.42 ± 4.16 s ($P = 0.195$). The mean duration of blind endotracheal intubation through the Air-Q ILA was 24.88 ± 14.75 s in group S and 17.57 ± 5.35 s in group L ($P = 0.002$). In both the groups, none of the children had bronchospasm, laryngospasm, desaturation, or aspiration. The airway trauma evident by blood staining on the Air-Q ILA on removal was revealed in 2 cases in group S, and 3 cases in group L. None of the children in group S and 4 children in group L had postoperative stridor. Postoperative hoarseness was reported in 3 children in group S and none in group L within 24 hours.

Conclusion: The Air-Q ILA can be used as a conduit for blind orotracheal intubation in children in both supine and lateral positions while maintaining an effective airway seal.

Keywords: Air-QILA, lateral, orotracheal intubation, position, supine, supraglottic airway

Address for correspondence: Prof. Ravinder K. Pandey, Department of Anaesthesiology, Pain Medicine and Critical Care, Room No. 5016, 5th Floor Teaching Block, All India Institute of Medical Sciences, Ansari Nagar, New Delhi - 110 029, India. E-mail: ravindrapandey1972@gmail.com

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Introduction

Supraglottic airway devices (SAD) are an essential element of pediatric airway management. However, there are several conditions where tracheal intubation is desired. Conventionally, endotracheal tubes (ETT) are placed under vision through direct laryngoscopy.^[1,2] The usefulness of various airway devices like SADs that facilitate tracheal intubation either blindly or guided by fiberoptic and bougie has been established in the literature. Air-Q intubating laryngeal Airway (Air-Q ILA) is the SAD in pediatric patients intended to serve as a portal for tracheal intubation with cuffed endotracheal tubes.^[3,4] It also has several structural characteristics with the intubating laryngeal mask airway, usually unavailable for children weighing <30 kg.^[5,6]

The child may require airway management in positions other than supine in situations like trauma, emergency airway management during ongoing surgery in different positions or under regional anesthesia, and conditions like postoperative tonsillectomy bleed.^[7-9] These issues are critical since inappropriate airway control can have disastrous implications. No evidence-based approach is reported for airway management in lateral positions.^[10-13]

We conducted this study to compare tracheal intubation through Air-Q ILA and glottic view in lateral position compared to the supine position in children with a low predicted risk of the difficult airway. The primary outcome of this study was to compare the success rate of orotracheal intubation in children through Air-Q ILA as a conduit in supine vs. lateral position. The secondary outcomes were to record Air-Q ILA placement success and time, tracheal tube insertion time, Air-Q ILA removal time, significant airway trauma, esophageal intubation, and ETT dislodgement during Air-Q ILA removal.

Material and Methods

Following the Institutional Ethics Committee's approval (IEC/ NP-379/08-10-2014), 100 children of the American Society of Anesthesiologists (ASA) physical status I, aged 6 months to 12 years, weighing 7–30 kgs, scheduled for elective surgery under general anesthesia needing endotracheal intubation were enrolled in this study. This prospective randomized comparative study was conducted over a period of one year from January 2019 to December 2019 at a tertiary care center. Children with craniofacial deformities (e.g. micrognathia, retrognathia) and cervical spine disease, dental abnormalities, surgeries of the oral cavity, prone to aspiration/severe gastrointestinal reflux, with respiratory and pharyngeal pathology, presence

of coagulation abnormality or any bleeding diathesis, allergic to any medications used in the study and refusal of parental consent were excluded from the study. The research protocol was described to parents and informed written consents and or assent were obtained.

The children were randomized into group supine (S) or group lateral (L) of 50 patients in each by block randomization using a random number table and allocation concealed in sequentially numbered opaque sealed envelopes. In Group S, both Air-Q ILA and ETT were placed in the supine position. In Group L, the child was placed into the lateral position, and the head was put on the pillows so that the sagittal axis of the head and neck were parallel to the tabletop and positioned in a sniffing position. Both Air-Q ILA and ETT were placed in lateral position.

All children were given 0.5 mg/kg of oral midazolam 30 min before transferring to the operating room. In the operating room, after attaching the standard monitors (pulse oximeter, electrocardiogram, non-invasive blood pressure), the anesthesia was induced with sevoflurane (in incremental doses starting from 2% to 8% till the loss of eyelash reflex) in 5-6 liters of oxygen (100%). After establishing a peripheral intravenous (IV) access, children were administered IV glycopyrrolate 4 µg/kg, followed by administration of fentanyl (2 µg/kg), and neuromuscular blockade was obtained with atracurium (0.5 mg/kg) IV. Mask ventilation was provided with sevoflurane in 100% oxygen for 3 minutes, and sevoflurane MAC of 1-1.2 was maintained in all the children before the Air-Q ILA was placed. The children were positioned supine or lateral according to the randomization as described previously. A well-lubricated, appropriately sized Air-Q ILA, as recommended by the manufacturer, was placed by an investigator who had the experience of putting Air-Q ILA in at least 25 pediatric patients. The cuff was inflated as per manufacturer recommendations. The effective Air-Q ILA positioning was assessed by the possibility to attain at least 6-7 mL/kg tidal volume and bilateral chest expansion with the presence of a square waveform of end-tidal carbon dioxide (EtCO₂) with positive pressure ventilation. If the seal was inadequate, the Air-Q ILA was removed and reinserted. With the help of the pressure gauge, the airway leak pressure was assessed and recorded with the expiratory valve closed and a fresh gas flow of 3 L/min until an audible noise was detected. Airway pressure was not permitted to reach 30 cm of H₂O. The glottic view was assessed by an anesthesiologist, having an experience of at least 6 years of Fiberoptic bronchoscopy (FOB), and graded^[3] as Grade 1: only larynx visible Grade 2: larynx and epiglottis posterior surface visible, grade 3: larynx and epiglottis tip of the anterior surface visible, <50% visual obstruction of the epiglottis to

the larynx, grade 4: epiglottis folded down and the anterior surface seen, >50% visual obstruction of the epiglottis to the larynx, grade 5: epiglottis folded down and larynx cannot be seen directly.

Glottis view grade was blinded to the individual performing orotracheal intubation through Air-Q ILA. The polyvinyl chloride (PVC) endotracheal tube (ETT) was softened with sterile warm saline to reduce airway trauma. The Air-Q ILA's detachable connector was removed, and a well-lubricated adequate size ETT was introduced through it into the trachea (ATTEMPT 1). If the resistance to the passing of the ETT was noted, then the epiglottic infolding was assumed, and the device was withdrawn for 1-2 cm and re-inserted with a mandibular lift (Klein's maneuver), the ETT was again passed (ATTEMPT 2) through the Air-Q ILA with neck flexion and minimal cricoid pressure. If the second attempt at tracheal intubation failed, then tracheal intubation through Air-Q ILA was deemed a failure, and conventional laryngoscopy was permitted, and the trachea was intubated with an adequate size ETT. Successful endotracheal intubation was verified by bilateral chest rise, bilateral comparable air entry, and square waveform of EtCO₂. After successful intubation, Air-Q ILA was withdrawn utilizing the stylet given by the manufacturer. The time for Air-Q ILA's removal was also recorded.

Anesthesia was maintained with oxygen, nitrous oxide (50:50), and sevoflurane (MAC 1-1.2) during surgery. Intraoperative analgesia and neuromuscular blockade were managed with intermittent fentanyl (0.5 µg/kg) and atracurium (0.25 mg/kg) boluses whenever heart rate and systolic BP rose by 20% or more from baseline. After surgery, the residual neuromuscular blockade was antagonized, and the trachea was extubated once the standard extubation criteria were fulfilled.

When removing the Air-Q ILA and ETT, the note was made if blood was visible on the device. An independent observer recorded the data. The Air-Q ILA insertion time was defined from when the device entered the mouth until the capnograph waveform appears with positive pressure ventilation. The tracheal tube insertion time started with the ETT entrance through the Air-Q ILA till the appearance of the capnograph waveform. Similarly, the time for the second attempt was registered. Insertion time was the sum of all attempts. It didn't include the gap between attempts. The time to remove of Air-Q ILA was between disconnecting the breathing circuit from the ETT and reconnecting the circuit with the ETT after removing the Air-Q ILA. Total time was recorded from the time the supraglottic airway was put to the time the Air-Q ILA was removed, and the position of the tracheal tube was confirmed by EtCO₂. A significant

airway event was defined as desaturation <90%, change in voice, or other significant adverse events. The note was taken on laryngospasm, bronchospasm, significant bradycardia, and hypotension.

Statistical analysis

As there is no previous study on the blind tracheal intubation through Air Q ILA in supine and lateral position in children was available, we calculated the sample size to detect an effect size of 30% difference between the 2 groups. Using this for sample size calculation, we estimate a sample size of 50 per group at 95% CI, 90% power, and 20% contingency. Data were analyzed using SPSS version 23. Nominal data were described using frequency and percentages and analyzed using the Chi-Square test or Fisher's Exact test. Continuous Data has been described using mean and standard deviation and analyzed using an independent sample *t*-test. A *P* value of less than 0.05 is considered statistically significant.

Results

We assessed 108 children for eligibility in the study. Eight patients were excluded (six not met the inclusion criteria, and two declined to participate). Finally, 100 children were included in this study [Figure 1]. The demographic characteristics of the patients are shown in Table 1. The mean age in the S group was 7.1 ± 3.3 years and 6.6 ± 3.2 years ($P = 0.456$). The mean weight in the S group was 19.9 ± 7.0 kg, and in the L group was 20.8 ± 7.5 ($P = 0.559$). The different cuffed and uncuffed endotracheal tubes used for blind intubation are shown in Table 2.

The Air-Q ILA placement was successful in the first attempt of 47 of 50 children in group S and 48 of 50 children in group L. Three children in group S and 2 in group L required a second attempt for Air-Q ILA placement. All children had adequate cuff seals. The mean cuff seal pressure was 16.04 ± 4.96 cm H₂O. in group S and 15.94 ± 4.68 cm H₂O. in group L ($P = 0.918$). The successful blind orotracheal intubation via Air-Q ILA in the first attempt was observed in 37 children in group S and 43 in group L ($P = 0.134$), which improved to 45 and 47 children in group S and group L respectively in the second attempt ($P = 0.715$). Intubation was unsuccessful in 5 children in group S and 3 in group L, wherein direct laryngoscopy-guided endotracheal intubation was successfully achieved in all patients.

The glottic view grading using FOB by Air-Q ILA in the supine and lateral positions are shown in Table 3. The grade 1 glottic view was seen in the maximum number of children in both groups. Eighty percent of patients in group L and 70% in group S had glottis grade 1 or 2 compared to grade 3, 4,

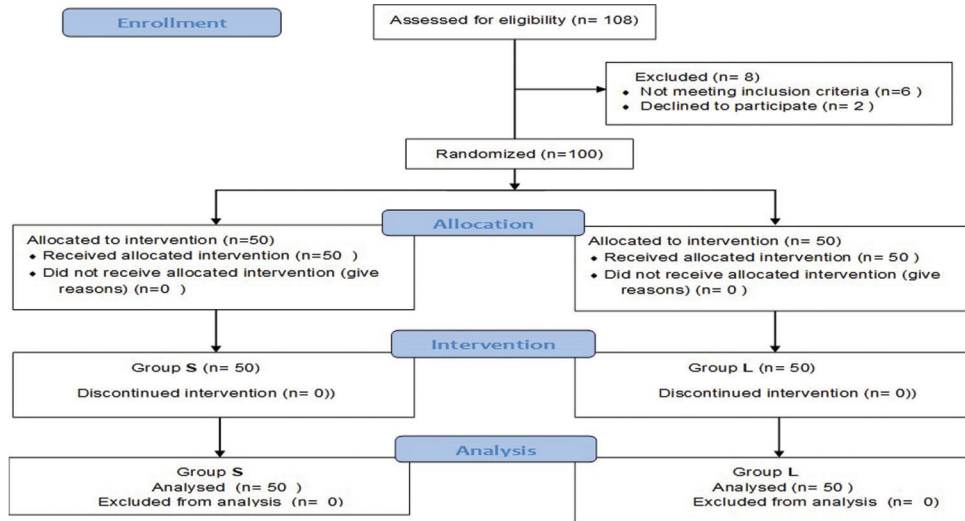


Figure 1: Consort Flow diagram

Table 1: The demographic profile

Variables	Group				P
	Supine		Lateral		
	n	%	n	%	
Age (years)					
<5	13	26.0%	15	30.0%	0.405
5-10	30	60.0%	32	64.0%	
>10	7	14.0%	3	6.0%	
Sex					
Male	36	72.0%	39	78.0%	0.488
Female	14	28.0%	11	22.0%	
Weight (Kg)					
10-15	4	8.0%	5	10.0%	0.559
15-20	18	36.0%	13	26.0%	
20-25	20	40.0%	22	44.0%	
25-30	8	16.0%	10	20.0%	

Table 2: The type and size of endotracheal tube used with the Air-Q Intubating Laryngeal Airway (Air-QILA) for endotracheal intubation

Types of tubes	ET Size (mm ID)	Used in patients (n)
Cuffed tube	4.0 mm ID	4
	4.5 mm ID	2
	5.0 mm ID	28
	5.5 mm ID	23
	6.0 mm ID	8
	6.5 mm ID	1
Uncuffed tubes	4.0 mm ID	2
	4.5 mm ID	8
	5.0 mm ID	9
	5.5 mm ID	15
	6.0 mm ID	0
	6.5 mm ID	0

5 (P = 0.249). The relative success of blind orotracheal intubation in the supine position via the Air-Q ILA is shown

in Tables 3 and 4. Air-Q ILA’s first attempt success rate of blind endotracheal intubations was highest in grade 1 glottic views accompanied to grade 2,5,4 and 3 in group S. It was maximum in grade 1 (92%) glottis view followed by 2 and 3 with no patient had grade 4 and 5 in group L.

The mean (SD) time of Air-Q ILA placement in groups S and L was 15.73 ± 5.64 s and 14.42 ± 4.16 sec (P = 0.195). The mean (SD) time for the first attempt of blind endotracheal intubation through Air-Q ILA in groups S and L was 20.39 ± 7.59 s and 16.63 ± 5.21 sec (P = 0.006). The mean (SD) time for the second attempt of blind endotracheal intubation through Air-Q ILA in groups S and L was 19.60 ± 9.13 sec and 17.25 ± 11.17 sec (P = 0.682). The overall mean time for endotracheal intubation through Air-QILA in groups S and L was 24.88 ± 14.75 sec and 17.57 ± 5.35 sec (P = 0.002). The mean time for Air-Q ILA removal in group S and group L was 22.82 ± 7.57 sec and 17.57 ± 5.36 sec (P = 0.032) [Table 5].

In the sub-group analysis, mean (SD) Air-Q ILA removal time was observed to be more for cuffed endotracheal tubes than uncuffed endotracheal tubes (29.84 ± 9.58 versus 22.20 ± 8.75 in S group (P = 0.009) and 25.90 ± 7.14 versus 15.64 ± 3.00 in L group (p = <0.001) [Figure 2]. None of the children had desaturation during this removal period.

On subsequent analysis, we observed that successful endotracheal intubation with Air-Q ILA in children < 15 kg was achieved in 12 of 12 children in Group S and 7 of 10 children in Group L. In contrast, the success rate for blind endotracheal intubations by the Air-Q ILA in children weighing > 15 kg was 33 of 38 in Group S and 40 of 40 in Group L. The success rate for blind endotracheal intubation

Table 3: Comparison of different glottic views with successful blind endotracheal intubation (ETI) through the Air-Q ILA

	Group				ETT insertion Success or Failure				No. of attempts for ETI			
	Supine		Lateral		Success		Failure		1.0		2.0	
	n	%	n	%	n	%	n	%	n	%	n	%
Grading of Glottic view												
1	27	54.0%	26	52.0%	50	54.3%	3	37.5%	46	57.5%	7	35.0%
2	8	16.0%	14	28.0%	21	22.8%	1	12.5%	18	22.5%	4	20.0%
3	4	8.0%	10	20.0%	12	13.0%	2	25.0%	9	11.3%	5	25.0%
4	8	16.0%	0	0.0%	7	7.6%	1	12.5%	5	6.3%	3	15.0%
5	3	6.0%	0	0.0%	2	2.2%	1	12.5%	2	2.5%	1	5.0%

Table 4: Comparison of different glottic views with a number of attempts of successful blind endotracheal intubation (ETI) through the Air-Q Intubating Laryngeal Airway

	Group							
	Supine				Lateral			
	1 st attempt		2 nd attempt		1 st attempt		2 nd attempt	
	n	%	n	%	n	%	n	%
Grading of Glottic view								
1	22	59.5%	5	38.5%	24	55.8%	2	28.6%
2	6	16.2%	2	15.4%	12	27.9%	2	28.6%
3	2	5.4%	2	15.4%	7	16.3%	3	42.9%
4	5	13.5%	3	23.1%	0	0.0%	0	0.0%
5	2	5.4%	1	7.7%	0	0.0%	0	0.0%

Table 5: Comparison of different time duration between supine and lateral group

	Group		P
	Supine Mean ± SD	Lateral Mean ± SD	
Time for Air Q ILA Placement (seconds)	15.73 ± 5.64	14.42 ± 4.16	0.195
Time for blind ETT placement 1 st attempt (seconds)	20.39 ± 7.59	16.63 ± 5.21	0.006
Time for blind ETT placement 2 nd attempt (seconds)	19.60 ± 9.13	17.25 ± 11.17	0.682
Time for blind ETT placement Total (seconds)	24.88 ± 14.75	17.57 ± 5.35	0.002
Time for Removal of Air Q ILA (seconds)	22.82 ± 7.57	17.57 ± 5.36	0.032

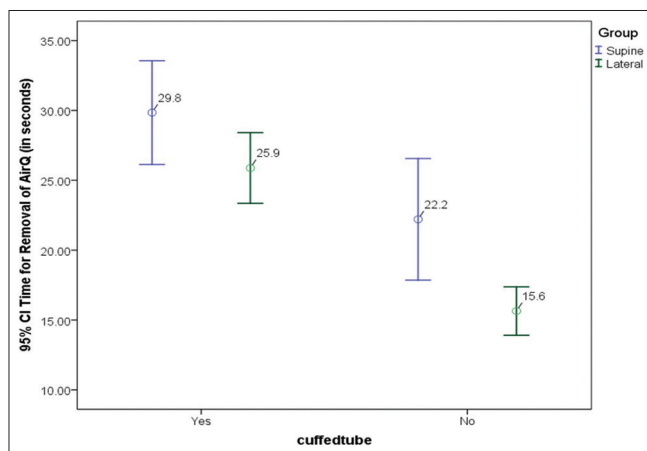


Figure 2: Air-Q ILA removal time for cuffed and uncuffed endotracheal tubes in supine and lateral group

was 100% in Group S and 77.8% in Group L in patients with the Air-Q ILA leak pressure >20 cm H₂O. It was 88.1% in Group S and 97.6% in Air-Q ILA with a leak pressure <20 cm H₂O.

Comparing the impact of cuffed and uncuffed ETT on the success of blind endotracheal intubation, we noticed that tracheal intubations were effective in 28 out of 31 children in group S and 33 out of 35 where cuffed endotracheal tubes were used relative to 17 out of 19 (89.5%) in group S and 14 out of 15 children in group L when uncuffed endotracheal tubes were used.

None of the children in group S had postoperative stridor. However, 4 children in group L had postoperative stridor. In both the groups, none of the children had bronchospasm, laryngospasm, desaturation, or aspiration. Air-Q ILA blood staining was found in the 2 children in group S and 3 in group L. Despite utilizing an endotracheal tube stabilizer; the endotracheal tube was displaced in one child in group L during Air-Q ILA removal. Also, in group S, esophageal intubation occurred in 5 children. However, no esophageal intubation occurred in group L. Postoperative hoarseness was reported in 3 children in group S and none in group L within

24 hours. These children were followed by the mobile phones of their parents. In all three children, hoarseness of voice was resolved within two weeks.

Discussion

Our study observed that Air-Q ILA is an acceptable device for airway management and blind tracheal intubation in children in both lateral and supine positions.

Our group has earlier reported the worsening of glottic view through Air-Q ILA when the child is turned from supine to lateral position.^[6] However, in that study, intubation was not attempted in a lateral position. In the present study, the most common glottis view we encountered was grade 1 (54% in group S and 52% in group L). These findings vary from those found by Jagannathan *et al.*,^[14] who identified a grade 1 view in 31% of patients and grade 5 views in 27% of patients in the supine position. This may be due to a wider range of age groups (6 months to 12 years) in our study compared to 6 months to 8 years in the study by Jagannathan *et al.*^[14]

In the present study, the first attempt success rate of Air-Q ILA was comparable to previous studies.^[5,6,10] The overall time taken for endotracheal intubation through the Air-Q ILA was statistically significant ($P = 0.002$) among the two groups; however, the time difference appears to be clinically not relevant. The time taken is comparable to the previous study by Jagannathan *et al.*^[14] Though the success rate of overall endotracheal intubation was comparable in supine and lateral positions, endotracheal intubation via the Air-Q ILA was easier in the lateral position than the supine position for children who weighed >15 kg. To enhance glottis visualization, different maneuvers such as backpressure over the larynx, head extension and neck flexion, jaw thrust, withdrawal, and advancement of Air-Q ILA have been mentioned.^[10,15] FOB can measure the effectiveness and performance of such maneuvers. In this study, we used Klein's maneuver in 13 children in group S and eight children in group L to improve the efficacy of blind orotracheal intubation by Air-Q ILA. The utility of these maneuvers was assessed by improving the POGO score and increasing the rate of FOB directed intubations as described by Khan *et al.*^[15] Intubation through the Air-Q ILA can be done using cuffed or uncuffed endotracheal tubes. However, we found that the endotracheal tube pilot balloon becomes troublesome for Air-Q ILA removal.

Another unique result we found and inferred from our analysis was that the rate of successful intubation via Air-Q ILA was associated with Air-Q ILA leak pressure in a different

position. We noted that the success of blind endotracheal intubation was higher in the supine position (100 percent in Group S vs. 77.8 percent in Group L) when the airway leak pressure of Air-Q ILA was >20 cm H₂O. It was higher in the lateral position (88.1% in the S group vs. 97.6% in the L group) when airway leak pressure was <20 cm H₂O.

The airway trauma evident by blood staining on the Air-Q ILA on removal was revealed only in 2 cases (4%) in group S and 3 cases (6%) in group L. This is slightly lower than the previous study, which recorded a 6.7% rate of airway trauma.^[16] In this study, there was no occurrence of laryngospasm, bronchospasm, and aspiration in the intraoperative period; these findings are similar to other previous studies.

Conclusion

To summarize, the Air-Q ILA is an easy-to-place supraglottic airway device with a good airway seal and low airway morbidity in children. It may be helpful for blind orotracheal intubation in both supine and lateral positions. The glottis view in the lateral position was comparable to the supine position.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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