Tweaking conventions: Use of high-flow nasal oxygen for intra-operative oxygenation in a parturient with severe COVID-19 acute respiratory distress syndrome

Sir,

The coronavirus disease 2019 (COVID-19) pandemic has prompted a myriad of amendments to minimise the spread of infection. In obstetric anaesthesia, recommendations advocate regional anaesthesia (RA) over general anaesthesia (GA).[1] In patients having mild-moderate acute respiratory distress syndrome (ARDS), RA is preferred.[2] Severe ARDS frequently necessitates GA to maintain oxygenation in the operating room (OR).[3] This article deliberates on the benefits and risks of GA versus RA for severe ARDS, and outlines a possible technique for intraoperative oxygenation.

We encountered a second gravida, at 38 weeks of gestation with COVID-19. Her chest radiogram showed bilateral, basal, peripheral infiltrates, consistent with COVID-19 ARDS [Figure 1]. In the intensive

care unit (ICU), on high-flow nasal oxygen (HFNO) (Airvo™2, Fisher and Paykel Healthcare, Auckland, New Zealand) with a fraction of inspired oxygen (FiO_2) of 0.9 and flow of 60 L/min, her respiratory rate (RR) was 40-45/min, saturation 90–92% and partial pressure of oxygen (PaO_2):FiO_2 <100 [Table 1]. A non-stress test performed on arrival to the ICU recorded a non-reassuring foetal heart rate, prompting an emergency lower segment caesarean section. In lieu of the chance of her respiratory embarrassment improving with relief from the gravid uterus, to avoid invasive ventilation and accompanying haemodynamic instability, since rescue prone positioning was not an option intraoperatively, and to forego the adverse effects of GA on the compromised lungs and foetus, RA was chosen, with GA for backup. In the OR, HFNO with FiO_2 1.0 at 60 L/min was administered. Non-invasive ventilation was avoided due to the elevated risk of aspiration in pregnancy. A subarachnoid block was administered in the left lateral position using 2 ml of 0.5% heavy bupivacaine. Her RR reduced to 40/min with no fall in oxygen saturation (SpO_2). A healthy neonate was delivered without significant blood loss. Vitals remained stable, with no deterioration in respiratory status. Despite termination, her respiratory distress persisted, necessitating intubation in the ICU after 18 hours. Two sessions of prone ventilation lasting 16 hours were given. Enoxaparin 0.6 ml subcutaneous twice daily was started 12 hours postoperatively. She was extubated on the fifth postoperative day and mother and baby were discharged after 1 week.

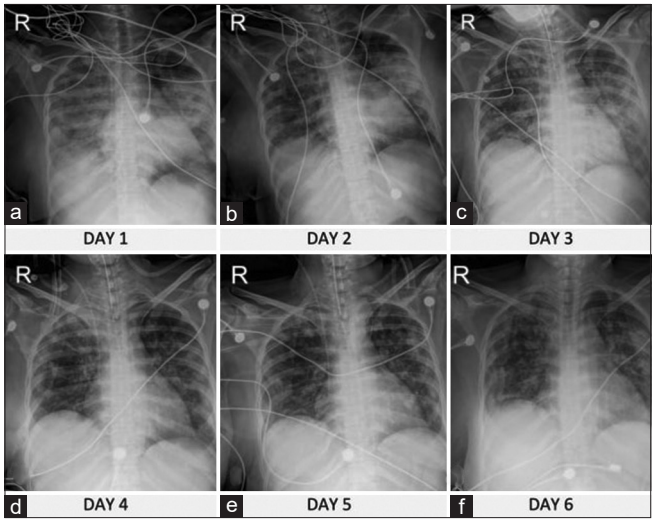

Figure 1: Serial chest radiograms in AP view of the patient during her stay in the ICU, showing progressive resolution of the lung infiltrates. (a) On the day of surgery, day 1. (b-e) On days 2 to 5 of ICU stay while the patient was on invasive mechanical ventilation. (f) Day 6 of ICU stay post-extubation

For the parturient with severe ARDS, intubation presents certain hazards. Due to a severely shortened apnoea time, hypoxia is frequent during intubation,

Table 1: Mode of oxygenation and the oxygen requirements of the patient during ICU stay, and the venous blood gas of the neonate at delivery

	Mother										Neonate
Events	**DAY 1**	**DAY 2**			**DAY 3**	**DAY 4**	**DAY 5**		**DAY 6**	**DAY 7**	**VBG at birth**
		Pre intubation	**Post intubation (Supine)**	**(Prone)**	**(Prone)**	**(Supine)**	**(Supine)**	**Post-extubation**			
Mode	HFNO	NIV	PCV	PCV	PCV	APV-CMV	PS	HFNO	HFNO	VM	Room air
PEEP (cm of H_2O)		6	15	14	11	10	6				
F/RR (/minute)		35	32	36	36	35	33	25		26	
Mve (L/minute)			12.2	15.5	14.7	12.7	13.3				
FiO_2	1	0.90	1	0.95	0.65	0.4	0.4	0.4	0.4	0.3	
Compliance (ml/cm of H_2O)			17	17.3	21.8	20	41.4				
SpO_2 (%)	90	91	84	94	96	95	96	97		95	98
PaO_2 (mmHg)	61.4	74.5	64.5	95.6	105.9	81.5	127.8	115	146.2	74.3	57.3
PaO_2/FiO_2 (mm of Hg)	61	83	64.5	100	162	203	320	288	365	247	
pH	7.34	7.28	7.12	7.15	7.30	7.40	7.35	7.41	7.40	7.42	7.38
$PaCO_2$ (mmHg)	32	45.3	70.2	56.2	40.6	34.4	47.9	41.5	41.3	37.2	39.3
HCO_3(mmol/L)	19.6	21.0	22.3	19.2	19.8	21.6	26.4	25.8	25.0	23.8	23.2
Base deficit	-6.1	-5.4	-7.0	-10.1	-6.1	-2.2	0.9	1.2	0.4	-0.6	1.1
Lactate (mmol/L)	2.04	2.02	1.50	1.9	1.8	1.89	1.96	1.41	1.71	1.95	1.48

PEEP: positive end expiratory pressure; F/RR: frequency/respiratory rate; Mve: minute ventilation; FiO_2: fractional oxygen concentration; SpO_2: peripheral oxygen saturation; PaO_2: partial pressure of oxygen; PaO_2/FiO_2: ratio of partial pressure of oxygen to fractional concentration of oxygen; HFNO: high-flow nasal oxygen; NIV: non-invasive ventilation; PCV: pressure control ventilation; APV CMV: adaptive pressure ventilation; PS: pressure support ventilation; VBG: venous blood gas; $PaCO_2$: partial pressure of carbon dioxide; HCO_3: bicarbonate

especially since the obstetric airway is notoriously difficult.[4] Therefore, airway adjuncts like bougie, stylet and videolaryngoscope should be at hand. Furthermore, GA can exacerbate atelectasis and ventilation-perfusion mismatch in a diseased lung. Also, haemodynamic perturbations frequently follow, which may affect the foetus. Though few reports of HFNO use during RA in severe ARDS exist,[5] it is infrequently used in the OR, although it may be a valuable alternative to intubation.

In severe ARDS, the patient compensates with rapid breaths of low tidal volumes. While the body regulates its ventilation to sustain oxygenation, it is often challenging to match with positive pressure ventilation without risking lung injury. Hence, when rescue postural manoeuvres such as prone positioning are not feasible, it may be best not to interfere with the patient's respiratory mechanics till conditions are appropriate. In our experience, most patients with severe COVID-19 ARDS require prone positioning to maintain oxygenation after initiation of mechanical ventilation.

The decision for RA must be individualised considering the use of anticoagulants, full-stomach status, haemodynamics and severity of respiratory distress. Though low-molecular-weight heparins are preferred for their predictability, unfractionated heparin is preferable when surgery or delivery is anticipated, due to its short duration of action and reversibility.[6] In our patient, due to an early decision to operate, no anticoagulant was administered, facilitating the decision for RA. Nonetheless, preparations for GA must always be ready in case of failure of RA or complications like high-spinal, local anaesthetic toxicity, anaphylaxis, etc.

To conclude, we report the successful use of HFNO in the OR with preserved spontaneous respiration in a parturient with severe ARDS, to circumvent the risks associated with GA and mechanical ventilation. The pros, cons and postoperative consequences should be considered before choosing the anaesthetic technique.

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Conflicts of interest
There are no conflicts of interest.

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