

# Perioperative management of post-COVID-19 surgical patients: Indian Society of Anaesthesiologists (ISA National) Advisory and Position Statement

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## PREAMBLE

The Indian Society of Anaesthesiologists (ISA) issues the following advisory and position statement pertaining to the perioperative management of post-severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) disease (COVID-19) in surgical patients.

With the second wave of COVID-19 receding, numerous patients who have recovered from the disease are reporting for elective/emergency surgery either for primary ailment or for a complication arising from COVID-19, such as mucormycosis. There is insufficient published literature, guidelines, or protocols regarding the perioperative management, morbidity and mortality of COVID-19-recovered patients. Many aspects of management are debatable and unclear. This position statement and advisory is aimed at guiding the anaesthesiologists in the safe perioperative management of the post-COVID-19 surgical patient population.

As the understanding of COVID-19 is improving, the guidelines and recommendations are also being updated regularly; nevertheless, this ISA advisory and position statement is also subject to change and updation in the coming days.

## ISA POSITION STATEMENT

- SARS-CoV-2 infection primarily affects the pulmonary and cardiac systems but has the potential for involvement of multiple systems with both short-and long-term sequelae. Post-COVID syndrome can include symptoms

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related to residual inflammation, organ damage, impact on pre-existing health conditions, non-specific effects due to hospitalisation or prolonged ventilation (post-intensive care syndrome). The patients can be on polypharmacy, including steroids and anticoagulants. All these factors can have significant implications, which make the perioperative management of post-COVID-19 patients challenging.

- Physiological impairment and radiological features of pulmonary fibrosis and interstitial lung disease (ILD) with impaired diffusion and decreased functional capacity have been observed in cohorts of patients followed for 3–6 months after recovery from SARS-CoV-2 infection.
- Elevated serum cardiac troponin levels, asymptomatic cardiac arrhythmias, or abnormalities in cardiac imaging may be the only cardiovascular post-COVID-19 manifestations. These patients are at an increased risk of left ventricular diastolic/systolic dysfunction, pulmonary arterial hypertension, heart failure, fresh myocardial infarction and arrhythmias, including premature ventricular complexes, ventricular tachyarrhythmias and atrial fibrillation due to healing myocarditis and myocardial fibrosis. Inappropriate sinus tachycardia or bradycardia can also be seen as a component of the post-COVID-19 syndrome.
- COVID-19 results in a hypercoagulable state and thrombotic events can occur during the acute illness or convalescence. The most common haemostatic abnormalities in COVID-19 include mild thrombocytopenia, increased D-dimer levels, prolongation of the prothrombin time (PT), international normalised ratio (INR), thrombin time (TT) and shortened activated partial thromboplastin time (aPTT).
- Moderate or severe SARS-CoV-2 infection is frequently associated with acute kidney injury (AKI). The duration of COVID-induced kidney injury is not clear, and renal consequences of COVID-19 may be found even six months after discharge.
- Hormonal and metabolic disturbances due to the involvement of the thyroid, pancreas and adrenal glands by the coronavirus have been reported. Direct viral damage to pancreatic islets due to coronavirus can lead to transient diabetes mellitus. Thyroid follicular damage, subacute

thyroiditis leading to primary hypothyroidism, transient pituitary lesions and damage to hypothalamo-pituitary-adrenal axis leading to hypocortisolism and secondary hypothyroidism have been reported in patients recovering from SARS-CoV-2.

- The most frequently reported long-term neurological sequelae of COVID-19 infection are anosmia, ageusia and cerebrovascular accidents.
- Fatigue and muscle weakness are the most common post-COVID-19 symptoms. Significant physical deconditioning, critical illness myopathy, residual neuromuscular weakness and increased frailty may be seen in patients recovering from severe COVID-19 and must be considered while assessing the perioperative risk.
- Psychiatric symptoms, including post-traumatic stress disorder, worsening of depression and anxiety, have been observed in COVID-19-recovered patients.
- Gastrointestinal and liver dysfunction with symptoms such as loss of appetite, nausea, acid reflux, diarrhoea, abdominal distension, belching, abdominal pain and bloody stools can persist up to six months post-COVID-19. Abnormal aspartate aminotransferase and alanine aminotransferase levels, low albumin and elevated lactate dehydrogenase levels are often observed.
- Cutaneous manifestations in COVID-19 patients may vary from urticarial, vesicular or maculopapular rash to various immune mediated inflammatory reactions.
- The full scope of the long-term effects of COVID-19 and their clinical implications have not yet been fully understood. Similar to acute COVID-19, there is considerable variability in the presentation and severity of its sequelae. Knowledge of COVID-19-induced systemic effects is essential for an anaesthesiologist for better perioperative management of post-COVID-19 patients.

## INDIAN SOCIETY OF ANAESTHESIOLOGISTS ADVISORY

### Perioperative management of post-COVID-19 patients scheduled for elective surgery

#### *Timing of elective surgery*

The optimal timing of elective surgery after recovery from COVID-19 must be decided after taking into account the magnitude and duration of COVID

symptoms, the disease severity, the presence of post-COVID-19 multiorgan dysfunction and drugs used for COVID-19 management that can affect perioperative outcomes.

The American Society of Anesthesiologists (ASA) and the Anaesthesia Patient Safety Foundation (APSF) have advised that COVID-19 patients wait a few weeks after recovery for non-urgent or elective surgeries; four weeks for those who recovered from mild, non-respiratory symptoms; six weeks for symptomatic (including cough and shortness of breath) patients who did not require hospitalisation; 8–10 weeks for symptomatic patients who are diabetic, immunocompromised or hospitalised with COVID-19; and a minimum 12 weeks for patients who were admitted in an intensive care unit (ICU) with COVID-19.

Reverse transcription-polymerase chain reaction (RT-PCR) tests can remain positive even after recovery. As per the Centres for Disease Control and Prevention (CDC), re-testing is not recommended within 90 days of onset of COVID symptoms. In case a patient presents for surgery after 90 days of onset of COVID symptoms, a nasopharyngeal RT-PCR test is recommended  $\leq 3$  days prior to the date of scheduled surgical procedure.

#### Pre-anaesthetic evaluation

In addition to the usual goals, pre-anaesthetic evaluation in a post-COVID-19 patient should primarily be aimed at assessment of the functional status of the patient, the assessment of sequelae of SARS-CoV-2 infection on various organ systems for optimisation and to find out if the patient is on any medications, which could influence peri-anaesthetic events.

Evaluation should include proper history and physical examination, including functional assessment and mandated investigations, along with meticulous documentation. Estimation of effort tolerance, breath-holding time, an ambulatory oxygen saturation measurement and a 6-min walk test (6MWT) should be performed in all patients before considering any further investigations. Objective tests that evaluate the cardio-pulmonary and nutritional status, renal and liver functions, coagulation system and inflammatory markers may be performed. The tests can be chosen based on the degree of index illness, ASA physical status of the patient and the nature of the planned surgical procedure [Table 1].

Any of these pre-operative tests may yield an abnormal value/values suggesting that the disease has not completely resolved, thereby signalling an increased risk of intra-or post-operative complications. Arterial blood gas (ABG) analysis is not mandatory because arterial puncture is associated with the risk of haematoma, nerve/arterial injury. Haemoglobin estimation may confirm anaemia, predict and prevent intra-operative hypoxaemia and increased myocardial workload, and can aid estimation of maximum allowable blood loss. White blood cell counts provide evidence of underlying infection and help differentiate extended COVID-19 symptoms from acute infections.

Liver function tests (LFTs) are not likely to alter anaesthetic management even in a post-COVID-19 patient. Routine LFTs before surgery should thus be offered to some select patients presenting for intermediate or major surgery. These include elderly patients, ASA physical status class III and IV patients, those with a history of severe COVID-19, pre-existing liver conditions and documented significant liver dysfunction. Evaluation of renal function tests (RFTs) among COVID-19 survivors is important. The RFTs may unearth residual renal insufficiency resulting in changes in drugs and their dosing schedules. RFTs are mandatory when drugs such as amphotericin B are being administered. Creatinine clearance measurement is the most accurate method for clinically assessing the overall renal function.

Mandatory pre-operative blood glucose testing (fasting and post-prandial) may be considered in COVID-19 patients with a history of steroid use, all patients with a history of severe COVID-19 disease and known patients of diabetes mellitus. Routine HbA1c estimation may be offered for diabetic patients if blood glucose values of the last 3 months are not available.

Chest radiograms (X-rays) may help to rule out an infective pathology when read in conjunction with other signs and symptoms. Most of the patients have persistent cough and diagnosis of active respiratory tract infection may cause delay or postponement of elective cases pending optimisation. Special care is warranted in elderly patients, those with a history of severe disease, a poor previous chest X-ray or poor computed tomography (CT) scan report. Clinical assessment, peripheral arterial oxygen saturation levels and chest X-ray provide useful information about the respiratory status of patients presenting for surgery.

**Table 1: Tests for pre-operative evaluation in post-COVID-19 patients**

Tests	*Minor Procedures		**Intermediate Procedures		***Major Procedures	
	*Asymptomatic (ASAPS-I)	**Symptomatic (ASAPS II, III, IV)	*Asymptomatic (ASAPS-I)	**Symptomatic (ASAPS II, III, IV)	*Asymptomatic (ASAPS-I)	**Symptomatic (ASAPS II, III, IV)
CBC (Hb, WBC differential count, Platelet count, others)	Yes	Yes	Yes	Yes	Yes	Yes
Coagulation profile (BT, CT, PT, INR, APTT)	Yes	Yes	Yes	Yes	Yes	Yes
CXR	No (If SpO2 normal/Clinically normal)	No (If SpO2 normal/Clinically normal)	No (If SpO2 normal/Clinically normal)	Yes	Yes	Yes
ECG	Yes	Yes	Yes	Yes	Yes	Yes
Serum Electrolytes	Yes	Yes	Yes	Yes	Yes	Yes
RBS	No	Yes	Yes	Yes	Yes	Yes
LFTs	No	No	No	No	No	Yes
RFTs (BUN, Serum Creatinine)	No	Yes	Yes	Yes	Yes	Yes
D-dimer	No	Yes	No	Yes	Yes	Yes
Fibrinogen	No	consider based on the severity of illness	No	Yes	Yes	Yes
NT Pro-BNP	No	Yes	No	Yes	Yes	Yes
LDH/Ferritin/prealbumin	No	consider based on the severity of illness	No	Yes	No	consider based on the severity of illness
2 D Echo	-Patients who had moderate/severe hypoxia or significant cardiac symptoms during COVID-19 -Patients posted for major abdominal/thoracic/cardiac/vascular surgeries -Geriatric patient -Obstetric patient -Those with signs of heart failure/abnormal ECG report/structural heart disease					
HRCT chest, PFTs, ABGs	-Patients who had moderate/severe hypoxia or significant cardiac symptoms during COVID-19 -Patients posted for major abdominal/thoracic/cardiac/vascular surgeries -Geriatric patients					
Troponin 1	-Patients who had significant cardiac symptoms during COVID-19 -Patients posted for major abdominal/thoracic/cardiac/vascular surgeries					

\*Asymptomatic – No symptoms or without respiratory symptoms during COVID-19 infection. \*\*Symptomatic – A) Cough, dyspnoea, but did not require hospitalisation during COVID-19 infection. B) Diabetic, immunocompromised or hospitalised during COVID-19 infection. C) Admitted to intensive care unit (ICU) during COVID-19 infection. †Minor surgeries - skin and superficial surgeries, including abscess drainages. ††Intermediate surgeries: inguinal hernia repair, varicose vein repair, tonsillectomy, adenoidectomy and arthroscopies. †††Major surgeries include the possibility of significant intra-operative fluid shifts. E.g. hysterectomies, endoscopic prostatectomy, thyroidectomies, joint replacements, thoracotomies, gut resections and neurosurgeries. ASAPS=American Society of Anesthesiologists physical status; CBC=Complete blood count; CXR=Chest radiogram; ECG=Electrocardiogram; ECHO=2D-Echocardiogram; RFT=Renal function tests; BUN=Blood urea nitrogen; RBS=Random blood sugar; LFT=Liver function test; PT-Prothrombin time; INR=International normalised ratio; APTT=Activated partial thromboplastin time; LDH=Lactate dehydrogenase; NT-Pro-BNP=N-terminal-pro-brain natriuretic peptide; SpO2=Peripheral oxygen saturation; INR=International normalised ratio; PFTs=Pulmonary function tests; ABGs=Arterial blood gases; Hb=Haemoglobin; BT=Bleeding time; CT=Clotting time; HRCT=High resolution computed tomography

The previous ECG of all patients with moderate to severe COVID-19 and treated in ICU should be evaluated. A low threshold can be kept for ordering an echocardiogram when drugs such as amphotericin B are being used.

Clinical features of primary/secondary hypothyroidism and hypocortisolism, such as fatigue, lassitude, weakness, malaise, orthostatic dizziness, anorexia, anxiety, depression and apathy, postural hypotension and low blood pressure, should be looked for. Serum thyroid-stimulating hormone and free thyroxine (T4) levels can be estimated if hypothyroidism is suspected. Serum cortisol estimation in the morning and

adrenocorticotrophic hormone (ACTH) stimulation test can be advised in cases of suspected hypocortisolism and supplemental corticosteroids administered depending on the test results. The dose of perioperative steroid supplementation will depend on the type of surgical procedure. Supplemental perioperative corticosteroids are not indicated in those who have taken corticosteroids for less than three weeks/taken less than the equivalent of 5 mg of prednisolone daily/those undergoing superficial surgical procedures.

It is pertinent that during the pre-operative evaluation, the clinical assessment of COVID-19-recovered patients

should be individualised, considering the severity of the disease, their post-COVID-19 functional status, associated co-morbidities, the surgical procedure and the benefit-risk ratio of postponement of surgery.

#### **Pre-operative optimisation**

Prehabilitation and multidisciplinary optimisation is desirable. Patients awaiting surgery are recommended to accept a vaccine unless contraindicated. If possible, the vaccination should be given several weeks before surgery to reduce the risk to patients and lessen the risk of nosocomial SARS-CoV-2 infection to other patients and staff. There is currently no evidence that either COVID-19 or the vaccine interferes with anaesthesia. However, surgery is stressful to the body and temporarily puts extra strain on the immune system; the patient can wait until he/she is fully immunised after vaccination before proceeding with elective surgery. The surgery should be preferably scheduled two weeks after the second dose of the vaccine.

Cessation of smoking, chest physiotherapy, use of bronchodilators, correction of hydration status, improvement in nutrition, adjustment of the dose of corticosteroids and control of hyperglycemia, including adjustment of insulin doses, and treatment of ketoacidosis are important.

#### **Perioperative management of antithrombotic and anti-platelet agents**

COVID-19-recovered patients may be on anti-platelet agents (such as low-dose aspirin), clopidogrel/prasugrel/ticagrelor/ticlopidine, low molecular weight heparin (LMWH)/unfractionated heparin, Factor Xa inhibitors (such as fondaparinux) and direct oral anticoagulants (DOACs) such as betrixaban/rivaroxaban/apixaban/dabigatran. Of these, the use of low-dose aspirin (75–150 mg/day) is safe and no special precautions are to be taken unless the patient presents for eye, prostate or neurosurgery. For patients at high risk of cardiac events (except those with coronary stents), clopidogrel/prasugrel is discontinued 5 days preoperatively and is resumed 24 h post-operatively. For patients at low risk of cardiac events, dual anti-platelet therapy is stopped 7–10 days preoperatively and resumed 24 h post-operatively. For those with coronary stents, dual anti-platelet therapy, including aspirin and clopidogrel/prasugrel, is continued perioperatively if surgery cannot be postponed. For those taking a once-daily dose of LMWH (prophylactic), it is

prudent to intervene at least 12 h after the last dose and restart 24 h after surgery. However, if the dose is twice daily (therapeutic), or if the patient is on Factor Xa inhibitors, one should wait for at least 24 h before any intervention. There is a need to check for heparin-induced thrombocytopenia in patients on more than 4 days of unfractionated heparin therapy.

DOACs should ideally be discontinued 24–48 h prior to surgery depending on the risk of bleeding in the surgical procedure. They must be discontinued a minimum of 72 h prior to a neuraxial technique. The problem with the newer DOACs is that the antidotes, although present, are not easily available. In addition, the usual coagulation tests such as PT, INR and aPTT do not qualitatively or quantitatively assess the effects of DOACs. If the time interval is less than 72 h, the serum DOAC level/quantitative anti-Factor Xa assay is required. Whenever in doubt and if the facility exists, thromboelastograph or thromboelastometer can reliably provide the coagulation status of the patient in the perioperative period.

Despite these precautions, if an increase in bleeding is observed, the most reasonable solution would be to administer fresh frozen plasma (FFP). Although other anti-fibrinolytics, such as tranexamic acid, aprotinin and epsilon aminocaproic acid, have been used in cardiac, orthopaedic, obstetric and gynaecologic surgeries and major trauma to reduce blood loss, their use in post-COVID-19 surgical patients may be counterproductive as the underlying mechanism of coagulation dysfunction in COVID-19 disease has been thrombosis leading to increased D-dimer levels. The use of such agents may further promote thrombosis by inhibiting fibrinolysis with disastrous results. Studies regarding their use in the post-COVID-19 scenario are currently lacking.

#### **Intra-operative management**

Pre-operative anxiolysis and reassurance are important keeping in mind that the patients are very often anxious and stressed. The patient should be premedicated depending on the lung status with a short-acting benzodiazepine such as midazolam. As far as possible, regional anaesthesia (RA) is an important option. Optimal oxygenation by providing adequate inspired oxygen concentration should be ensured when administering general anaesthesia (GA). Heat and moisture exchange filters should be used to maintain mucociliary function. Propofol or etomidate

can be used as induction agents. Vecuronium, cis-atracurium and atracurium can be used as agents for neuromuscular blockade. Suxamethonium or rocuronium can be used for rapid sequence tracheal intubation. The anaesthesia is maintained preferably with an air-oxygen mixture and inhalational agents such as sevoflurane/isoflurane/desflurane along with intra-operative analgesics, fentanyl. Adequate reversal of the neuromuscular block is important.

In patients with renal dysfunction, drugs that are normally excreted by the kidney, such as meperidine, are avoided because of altered drug pharmacokinetics. The use of non-steroidal anti-inflammatory drugs (NSAIDs), angiotensin-converting enzyme inhibitors and renally excreted antibiotics and muscle relaxants can be detrimental. Succinylcholine can be administered keeping in mind the possibility of hyperkalaemia due to renal failure/prolonged critical illness myopathy and rhabdomyolysis. Delayed gastric emptying secondary to autonomic neuropathy increases the risk of pulmonary aspiration. Use of renal replacement therapy, individualised fluid management to prevent congestive heart failure, avoidance of saline, use of haemodynamic monitoring, and careful selection of ventilatory strategies, including controlled ventilation to avoid inadequate ventilation, hypercarbia and resultant acidosis should be considered in those with AKI.

#### ***Intra-operative management in post-COVID-19 patients with cardiovascular manifestations***

It is important to initiate invasive haemodynamic monitoring with arterial catheterisation for continuous blood pressure measurement and to facilitate the usage of minimally or advanced invasive cardiac output monitors (if available) to measure cardiac output/index and dynamic variables (e.g., stroke volume variation) because unstable perioperative haemodynamics can induce myocardial injury. In institutes where transoesophageal echocardiography (TEE) is available, this is also a good choice and can serve as a guide to evaluate the left and right ventricular functioning perioperatively. The choice of anaesthetic technique (RA/GA) can be decided taking into consideration the goals of anaesthetic management, which include optimisation of preload, maximisation of forward flow, maintenance of stable haemodynamics, avoidance of myocardial depressant drugs and prevention of complications such as arrhythmias and precipitation of heart failure.

#### **Post-operative care including analgesia**

Shifting of the patient to the ICU/ward followed by oxygen supplementation and ventilatory support depending on the post-operative condition, presence of co-morbidities and degree of invasiveness of surgery is recommended. Judicious monitoring of haemodynamics and adequate analgesia, especially for those with cardiovascular problems, are important to prevent any untoward cardiovascular events. Multi-modal analgesia can be provided using epidural analgesia, nerve blocks, neuromodulators, opioids, tramadol, paracetamol and NSAIDs. NSAIDs should be avoided in those with renal dysfunction.

#### **Perioperative management of emergency surgery in post-COVID-19 patients**

This can be challenging because of the limited time available for pre-operative evaluation and optimisation. A thorough history and clinical examination will inform regarding the patient's post-COVID-19 functional status. A thorough respiratory and cardiac examination is warranted in all cases. The oxygen saturation on room air and the respiratory rate at rest should be noted.

Laboratory work-up should include a complete blood count, liver and kidney functions and a full coagulation profile. In addition, D-dimers and serum brain natriuretic peptide (BNP) levels can be assayed. Elevated D-dimers can indicate a persistent need for thromboprophylaxis and a low index of suspicion for pulmonary emboli. BNP levels are a valuable indicator of heart failure, especially in emergency scenarios where time constraints preclude echocardiography. A chest X-ray and an ECG should be procured for all these patients. A baseline ABG analysis on room air and a breath-holding test can provide bedside quantification of the cardio-pulmonary reserve. It may not be possible to do the 6 MWT because of unfavourable patient conditions in an emergency; hence, it may be performed wherever feasible. Capillary blood glucose should be monitored and in case of gross derangements, ketoacidosis should be looked for and evaluated. A thorough airway evaluation and appropriate planning are essential. Appropriate informed consent documenting the risks of anaesthesia in the light of prior COVID-19 illness is essential. Patients with poor pulmonary status should be counselled regarding the possibility of post-operative elective mechanical ventilation.

Wherever feasible, RA including neuraxial blocks and ultrasonography-guided nerve blocks should be preferred over GA, especially in patients with evidence of significantly decreased reserves. Prior to neuraxial anaesthesia, thromboprophylaxis and coagulopathy should be ruled out.

Wherein time permits, pre-operative optimisation of patient condition should be attempted. Nebulisation with bronchodilators along with optimisation of hydration, acid-base status and electrolytes can be done. Ongoing therapeutic anticoagulation can be a major challenge for emergency surgery. For emergency procedures, the effect of LMWH can be reversed by transfusion of 10–15ml/kg of FFP. Prolonged high dose corticosteroids may precipitate adrenal suppression and necessitate steroid cover for the peri-operative stress.

Arrangements should be made to ensure the availability of adequate blood and blood products. With anticipated pulmonary and cardiac compromise, it may be prudent to keep a higher transfusion trigger in these patients, attempting to maintain a haematocrit not lower than 27.

For GA, monitoring may be extended to neuromuscular monitors and bispectral index to appropriately titrate anaesthetic agents and muscle relaxants and avoid over-medication so as to minimise residual effects at the end of surgery. Prior to induction, pre-oxygenation for 3–5 min should be practised in all cases. Nasal oxygenation during tracheal intubation (to avoid desaturation) is advisable in all these cases. Induction agents should be carefully titrated to minimise haemodynamic perturbations, especially in cases with suspected myocardial dysfunction. Caution should be exercised in the usage of succinylcholine in patients with a history of prolonged immobility and neuromuscular weakness. Endotracheal intubation may be preferred in view of anticipated decrease in pulmonary compliance.

Sevoflurane may be preferred for maintenance of anaesthesia considering its effective bronchodilation effect and rapid removal. In patients demonstrating stiff lungs with higher pressures, lung-protective ventilation with lower tidal volumes or pressure-controlled ventilation may be utilised. Higher positive end-expiratory pressure should be employed cautiously, especially in well-established ILD, to avoid potential barotrauma. A higher fractional inspired concentration of oxygen (FiO<sub>2</sub>) may be required to maintain adequate oxygenation.

Trauma, emergency caesarean sections and exploratory laparotomies are the most likely emergency scenarios which will be encountered. Multimodal analgesia should be employed in all cases. Epidural analgesia should be planned in laparotomies and employed where feasible to optimise post-operative analgesia and ease breathing. Extubation needs careful assessment and planning. Nitrous oxide should be switched off early to allow complete washout. Complete reversal of neuromuscular blockade should be ensured. Opioid top-ups should be timed to avoid undue sedation at the time of extubation. Awake extubation should be performed provided the patient does not have any significant cardiac ailment. Post-extubation continuous positive airway pressure or high-flow nasal oxygen can be administered where necessary. Patients should be monitored closely for respiratory failure or deterioration. Post-operative thromboprophylaxis can be considered for all patients.

For emergency caesarean section in COVID-19 recovered women, all the above-mentioned considerations hold true. RA is the preferred technique, wherever feasible. GA should be preferred in patients with decreased cardio-pulmonary reserve. Rapid sequence induction is employed. A higher FiO<sub>2</sub> may be maintained till foetal delivery to ensure adequate foetal oxygenation considering the poor maternal pulmonary reserve. Good post-operative analgesia should be provided. A transversus abdominis plane block may be employed. Mechanical and pharmacological thromboprophylaxis should be considered post-operatively while targeting early ambulation.

#### *RA in patients on anticoagulation*

If the procedure is emergent, the patients should not receive RA. Incidence of spinal haematoma is increased in these cases when RA is attempted. The specific medication and the timing of the last dose of antithrombotic medications are vital for planning neuraxial/deep perineural procedures. The recommended minimum time interval between antithrombotic agent administration and neuraxial puncture/catheter removal (before puncture/removal and after puncture/catheter manipulation/removal) is as follows: 1) Prophylactic/therapeutic unfractionated heparin: 4–6 h, 1 h; 2) Prophylactic LMWH: 12 h, 4 h; 3) Therapeutic LMWH: 24 h, 4 h; 4) Fondaparinux: 36–42 h, 6–12 h; 5) Rivoroxaban/Apixaban: 22–30 h, 6 h. 6) Dabigatran: 5 d, 6 h (The experience with dabigatran and neuraxial anaesthesia is limited). The

recommended time interval between discontinuation of anti-platelet agents and neuraxial puncture is as follows: Clopidogrel/ticagrelor: 5–7 d; prasugrel: 7–10 d; ticlopidine: 10 d; cangrelor: 3 h. They can be resumed 6 h after puncture/catheter removal. All these drugs are contraindicated with the catheter in place.

The above document is an advisory and position statement based on current literature, resources and expert opinion. It is pertinent to state that new evidence is continuously emerging and guidelines are being issued regularly.

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### Conflicts of interest

There are no conflicts of interest.

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