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Combined Spinal-Epidural Anaesthesia for Caesarean Delivery in a Parturient With Advanced Cystic Fibrosis and Acute Hypoxaemic Respiratory Failure: A Case Report

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Abstract

Pregnancy in patients with advanced cystic fibrosis (CF) presents significant challenges due to the risk of respiratory deterioration, pulmonary exacerbations, and preterm delivery. Anaesthetic management requires careful consideration of maternal respiratory reserve and the risks associated with general anaesthesia and airway instrumentation.

An 18-year-old primigravida with advanced CF and severe respiratory impairment was admitted at 33 weeks and 3 days of gestation for maternal and fetal surveillance. She subsequently developed a pulmonary exacerbation complicated by acute hypoxaemic respiratory failure, requiring intensive care admission, antimicrobial therapy, and high-flow nasal cannula (HFNC) support. At 34 weeks and 1 day, progressive preterm labour prompted an urgent caesarean delivery. Given the severity of her respiratory compromise, combined spinal-epidural (CSE) anaesthesia was selected to avoid general anaesthesia and tracheal intubation. The technique involved intrathecal hyperbaric bupivacaine and sufentanil, followed by epidural ropivacaine supplementation to achieve an adequate sensory block. HFNC support was maintained throughout the procedure, with no intraoperative respiratory deterioration or haemodynamic instability. The neonate had Apgar scores of 9, 9, and 9 at one, five, and ten minutes, respectively. Postoperatively, the patient returned to the intensive care unit for respiratory monitoring and support. Her oxygen requirements progressively decreased, and she was discharged on postoperative day seven without supplemental oxygen.

This case illustrates the feasibility of CSE anaesthesia for urgent caesarean delivery in a parturient with advanced CF and acute hypoxaemic respiratory failure. Individualised anaesthetic planning, multidisciplinary coordination, continuation of HFNC support, and preparation for potential conversion to general anaesthesia were central to the perioperative strategy. Although a single case cannot establish the superiority of CSE over alternative techniques, it highlights the potential role of neuraxial anaesthesia in selected high-risk parturients with severe respiratory compromise.

Categories: Obstetrics/Gynecology, Anesthesiology
Keywords: cesarian delivery, combined spinal-epidural anesthesia, cystic fibrosis, high-flow nasal canula, obstetric anesthesia

Introduction

Cystic fibrosis (CF) is a multisystem genetic disorder characterised by progressive pulmonary disease, chronic airway infection, and variable degrees of respiratory impairment. Advances in diagnosis and treatment, particularly the introduction of cystic fibrosis transmembrane conductance regulator (CFTR) modulator therapies, have improved survival and increased the number of women with CF reaching reproductive age and becoming pregnant [1,2].

Pregnancy in women with advanced CF remains high-risk because of the increased physiological demands of pregnancy and the limited respiratory reserve associated with severe pulmonary disease. Advanced CF is characterised by substantial pulmonary impairment, recurrent respiratory exacerbations, chronic airway infection, and progressive loss of lung function, which may ultimately lead to consideration of lung transplantation. These patients are particularly vulnerable to respiratory deterioration and infectious complications. Consequently, delivery planning and anaesthetic management require individualised assessment and close collaboration between obstetric, anaesthetic, respiratory, and intensive care teams [1-3].

Anaesthetic management is particularly challenging when urgent caesarean delivery is required in the presence of advanced pulmonary disease and acute respiratory failure. Pregnancy is associated with increased oxygen consumption and reduced functional residual capacity, potentially accelerating desaturation in patients with limited respiratory reserve. General anaesthesia may further increase

respiratory risks through airway instrumentation and positive-pressure ventilation, whereas neuraxial techniques require careful dosing to avoid excessive cephalad spread and haemodynamic compromise [3,4]. High-flow nasal cannula (HFNC) is a non-invasive respiratory support technique that delivers heated and humidified oxygen at high flow rates through specialised nasal prongs, providing improved oxygen delivery and potentially reducing respiratory effort. It may be useful in selected patients who can maintain spontaneous ventilation; however, close monitoring and a contingency plan for airway management remain essential [5,6].

Previous reports have described neuraxial anaesthesia, including combined spinal-epidural (CSE) anaesthesia, for caesarean delivery in women with moderate to severe CF and even end-stage respiratory failure [7-9]. However, evidence remains limited regarding its use during urgent delivery in the setting of acute hypoxaemic respiratory failure requiring HFNC support. We report the multidisciplinary management of an 18-year-old primigravida with advanced CF who underwent urgent caesarean delivery under CSE anaesthesia while HFNC support was maintained throughout the procedure. This case highlights the anaesthetic challenges of managing a patient with severely impaired pulmonary reserve, particularly the need to minimise respiratory deterioration, carefully control neuraxial block height, and maintain readiness for emergency conversion to general anaesthesia.

This case was previously presented as a poster at Euroanaesthesia 2026 in Rotterdam from June 6 to 8, 2026.

Case Presentation

An 18-year-old primigravida with CF was admitted at 33 weeks and 3 days of gestation for maternal and fetal surveillance. She was homozygous for the F508del variant and had been diagnosed with CF at two years of age. Her disease course was characterised by severe respiratory insufficiency, with ongoing evaluation for lung transplantation, and exocrine pancreatic insufficiency. She had chronic airway colonisation with methicillin-sensitive *Staphylococcus aureus* (MSSA) and *Achromobacter xylosoxidans*, for which she received inhaled tobramycin or colistin in alternating 28-day cycles. She had also been receiving triple CFTR modulator therapy with elexacaftor/tezacaftor/ivacaftor for several years before the current admission. Her medical history was notable for frequent pulmonary exacerbations, multiple hospital admissions, suboptimal treatment adherence, and a previous spontaneous right-sided pneumothorax. She had no known drug allergies.

Pulmonary function tests had last been performed five years before pregnancy. They showed reduced forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and expiratory flows, with a preserved FEV_1/FVC ratio. No significant bronchodilator response was observed following inhaled salbutamol. However, inadequate patient cooperation limited the reliability of the results. At that assessment, her peripheral oxygen saturation (SpO_2) was 96% on room air, and her heart rate was 144 beats/min.

During pregnancy, she had required two previous hospital admissions for lower respiratory tract infections. At seven weeks of gestation, she was treated for an infection involving *Pseudomonas aeruginosa* and *Haemophilus influenzae*. Treatment included ciprofloxacin 500 mg twice daily for six days, amoxicillin for four days, and azithromycin for three days. This admission was complicated by a spontaneous right-sided pneumothorax. At 24 weeks of gestation, she was admitted with another lower respiratory tract infection caused by *Pseudomonas aeruginosa*, associated with type 1 respiratory failure. She received a 10-day course of ceftazidime guided by antimicrobial susceptibility testing.

During this admission, the patient developed dyspnoea, cough, fever (38.5°C), and a decrease in SpO_2 to 87% on room air. Laboratory investigations showed mild anaemia (haemoglobin 10.5 g/dL), no leukocytosis, and an elevated C-reactive protein (CRP) level of 82 mg/L. Urine culture was negative. Obstetric assessment showed a cephalic fetus with normal growth, amniotic fluid volume, and umbilical artery Doppler findings. Cardiotocography was reactive. After two days of hospitalisation, the patient requested discharge against medical advice and returned home.

On Day 4 after initial presentation (33 weeks and 6 days of gestation), the patient returned to the obstetric emergency department with dyspnoea on minimal exertion and abdominal pain consistent with uterine contractions. Arterial blood gas analysis and laboratory findings are summarised in Table *1*. Despite supplemental oxygen delivered through a Venturi mask at an FiO_2 of 0.40, arterial blood gas analysis revealed substantial hypoxaemia without hypercapnia or significant acid-base disturbance.

Variables	Result	Unit	Reference range
Haematological and inflammatory parameters			
Haemoglobin	9.8	g/dL	12.0–16.0
Platelet count	276	x 10^9/L	150–400
C-reactive protein (CRP)	222	mg/L	<5
Arterial blood gas analysis (Venturi mask, FiO_2 0.40)			
pH	7.437	—	7.35–7.45
PaO_2	69	mmHg	80–100
$PaCO_2$	39	mmHg	35–45
HCO_3^-	27.2	mmol/L	22–26
Lactate	1.6	mmol/L	0.5–2.0
PaO_2/FiO_2 ratio	≈173	mmHg	—

TABLE 1: Laboratory and arterial blood gas findings at the time of clinical deterioration.

CRP: C-reactive protein; FiO_2: fraction of inspired oxygen; PaO_2: partial pressure of arterial oxygen; $PaCO_2$: partial pressure of arterial carbon dioxide; HCO_3^-: bicarbonate.

Her blood pressure was 96/57 mmHg, consistent with her baseline, and her heart rate was 110 beats/min. She was tachypnoeic, with mild supraclavicular retractions, and pulmonary auscultation revealed coarse crackles over the right hemithorax. Chest radiography showed worsening infiltrates involving the right lower lobe and the posterior segment of the right upper lobe (Figure *1*).



FIGURE 1: Chest radiograph showing infiltrates in the right lower lobe and the posterior segment of the right upper lobe.

As her oxygen requirements increased, HFNC oxygen therapy was initiated. HFNC was initially delivered at a flow rate of 45 L/min and an FiO_2 of 0.50; however, the FiO_2 had to be progressively increased to 0.75 to maintain SpO_2 above 90%. In view of her worsening respiratory distress and escalating oxygen requirements, she was admitted to the intensive care unit (ICU) for close monitoring and treatment.

A diagnosis of lower respiratory tract infection associated with acute hypoxaemic respiratory failure in the context of advanced CF was established. Blood cultures and respiratory samples were collected, and empirical piperacillin/tazobactam was initiated based on previous respiratory microbiology. Obstetric examination revealed irregular uterine contractions, cervical shortening to 14 mm, and cervical dilatation of 1 cm with 50% effacement. The fetus remained in cephalic presentation, with reassuring Doppler and biophysical profile findings.

On Day 6 after initial admission (34 weeks and 1 day of gestation), the patient developed increasingly frequent and painful uterine contractions. The obstetric team initially administered nifedipine 10 mg and reassessed her five hours later. Cervical dilatation had progressed to 3 cm, with 80% effacement. Although her respiratory symptoms had partially improved with HFNC oxygen therapy, she remained tachypnoeic and continued to produce copious greenish sputum. In view of the progression of preterm labour and the risk of further maternal respiratory deterioration, a multidisciplinary team decided to proceed with urgent caesarean delivery.

Combined spinal-epidural (CSE) anaesthesia was selected to avoid general anaesthesia, tracheal intubation, and invasive mechanical ventilation in the setting of severe respiratory compromise. The decision followed multidisciplinary assessment of the patient's respiratory status and took into consideration her ability to maintain spontaneous ventilation, the absence of clinical respiratory deterioration despite substantial oxygen requirements, and her preference to remain awake for the birth of her child. Immediately before anaesthesia and surgery, the patient was conscious, cooperative, and able to tolerate the required positioning. Her SpO_2 was 93% while receiving HFNC at a flow rate of 45 L/min and an FiO_2 of 0.75. This support was maintained throughout the procedure, without an increase in oxygen requirements or worsening of dyspnoea.

Invasive arterial blood pressure monitoring, already in place in the ICU, was continued throughout the

procedure. General anaesthesia induction drugs and airway equipment were prepared in anticipation of possible conversion to general anaesthesia, with videolaryngoscopy planned as the first-line airway approach. Potential indications for conversion included persistent desaturation despite escalation of oxygen support, worsening respiratory effort or signs of fatigue, altered consciousness, inability to maintain adequate spontaneous ventilation, or an inadequate neuraxial block preventing surgery.

With the patient in the sitting position, a midline approach was used to access the L3-L4 interspace. The epidural space was identified using the loss-of-resistance-to-saline (LORS) technique with an 18-gauge Tuohy needle. A 27-gauge Whitacre spinal needle was advanced through the epidural needle into the subarachnoid space. After free flow of cerebrospinal fluid was confirmed, intrathecal hyperbaric bupivacaine 7.5 mg and sufentanil 2.5 µg were administered. An epidural catheter was then threaded, with 4 cm advanced into the epidural space. The catheter was secured at the 7-cm mark at the skin, corresponding to a skin-to-epidural-space distance of 3 cm. The CSE procedure was successful on the first attempt. No hypotension or significant heart rate changes occurred following intrathecal drug administration, and neither vasopressors nor additional intravenous fluids were required.

Ten minutes after intrathecal drug administration, the sensory block was considered insufficient for surgery. An additional 6 mL of 0.75% ropivacaine was therefore administered epidurally through the catheter to augment the block. Ten minutes after epidural supplementation, a bilateral sensory block to the T5 dermatome was confirmed using cold sensation.

The surgical incision was made 20 minutes after the intrathecal injection, and delivery occurred approximately five minutes after incision. No additional intraoperative analgesia or sedation was required. Throughout the procedure, SpO_2 remained stable at 93% with HFNC support at 45 L/min and an FiO_2 of 0.75. Intraoperative arterial blood gas analysis showed results comparable to the preoperative assessment, with no evidence of respiratory deterioration. The procedure was uneventful, and the newborn was delivered with Apgar scores of 9, 9, and 9 at one, five, and ten minutes, respectively [10]. The newborn did not require special care.

Following surgery, the patient returned to the ICU for continued respiratory support and monitoring. Her dyspnoea improved, although she continued to have thick respiratory secretions. During the first two postoperative days, 0.2% ropivacaine was administered epidurally in 6-mL boluses as needed for pain relief. Multimodal analgesia also included scheduled paracetamol and ketorolac every eight hours. The epidural catheter was removed on postoperative day three.

Four hours after caesarean delivery, the FiO_2 delivered through HFNC was reduced from 0.75 to 0.50, while the flow rate was maintained at 45 L/min. Respiratory support was progressively weaned over the following five days, allowing transition to conventional oxygen therapy via nasal cannula at 3 L/min. She was subsequently transferred to the ward and, after a further two days of inpatient care, was discharged on postoperative day seven without supplemental oxygen. No further complications were reported.

Discussion

CF is a multisystem genetic disorder caused by pathogenic variants in the CFTR gene. CFTR dysfunction impairs epithelial ion transport, resulting in dehydrated airway secretions, impaired mucociliary clearance, and chronic pulmonary infection. Extrapulmonary manifestations, including exocrine pancreatic insufficiency and nutritional impairment, may further complicate pregnancy. Advances in multidisciplinary care and CFTR modulator therapies have improved survival and reproductive prospects for women with CF. Nevertheless, pregnancy remains particularly challenging in patients with advanced pulmonary disease and limited respiratory reserve [1,2].

Pregnancy increases maternal oxygen consumption and minute ventilation, while the reduction in functional residual capacity decreases respiratory reserve and may increase susceptibility to hypoxaemia [11]. These physiological changes can be poorly tolerated in patients with severe underlying pulmonary disease. In the present case, advanced respiratory disease, previous spontaneous pneumothorax, and recurrent pulmonary infections contributed to a particularly challenging clinical context. The development of preterm labour during an acute pulmonary exacerbation required a multidisciplinary decision that balanced maternal respiratory status, obstetric urgency, and fetal well-being [1,2].

The anaesthetic management of caesarean delivery in patients with severe pulmonary disease requires an individualised approach. General anaesthesia may be necessary in patients with rapidly progressive respiratory failure, inadequate respiratory function, or an immediate need for delivery. It provides control over the airway and ventilation but introduces additional considerations in patients with CF, including secretion retention, bronchospasm, atelectasis, and the potential for barotrauma during positive-pressure ventilation. A previous spontaneous pneumothorax further emphasises the importance of careful ventilatory management. Pregnancy also increases the risks associated with airway management and aspiration [3,4,9]. In this patient, these considerations favoured neuraxial anaesthesia, provided that adequate surgical anaesthesia and respiratory stability could be maintained.

Neuraxial anaesthesia avoids airway instrumentation and may allow spontaneous ventilation to continue. However, it is not without risk in patients with severely impaired respiratory reserve. An excessively high sensory block may impair respiratory muscle function, while sympathectomy-related hypotension may compromise maternal haemodynamics and uteroplacental perfusion. The choice of technique should therefore account for respiratory effort, oxygen requirements, haemodynamic status, tolerance of positioning, and the urgency and anticipated duration of surgery [3,4,9].

In this case, the decision to proceed with neuraxial anaesthesia was based on the patient's preserved consciousness, ability to maintain spontaneous ventilation, clinical stability under HFNC support, and tolerance of the required positioning. Her preference to remain awake for delivery was also considered. Nevertheless, the decision required careful risk assessment, as her substantial oxygen requirements indicated limited respiratory reserve.

Combined spinal-epidural (CSE) anaesthesia was selected to combine the rapid onset of intrathecal anaesthesia with the flexibility of epidural supplementation. Intrathecal hyperbaric bupivacaine and sufentanil provided the initial neuraxial block, but the sensory level was considered insufficient for surgery after 10 minutes. Additional epidural ropivacaine was administered through the catheter, and a bilateral sensory block to the T5 dermatome was subsequently confirmed before incision. This sequence illustrates the practical advantage of having an epidural catheter available to augment an initially inadequate spinal block. The catheter also provided a means of administering postoperative analgesia. Nevertheless, this experience does not establish the superiority of CSE over other neuraxial techniques, and the possibility of inadequate or excessively extensive blockade, hypotension, and conversion to general anaesthesia must always be considered [3,4,9].

Preparation for possible conversion to general anaesthesia was an integral component of the management strategy. Induction drugs and airway equipment were immediately available, with videolaryngoscopy planned as the first-line airway approach. This preparation was particularly important given the patient's severe respiratory impairment and previous spontaneous pneumothorax. Invasive arterial blood pressure monitoring, established in the ICU, was continued intraoperatively, allowing continuous haemodynamic assessment and serial arterial blood gas analysis. The absence of significant haemodynamic instability following intrathecal drug administration, together with the lack of vasopressor or additional intravenous fluid requirements, suggests that the neuraxial technique was well tolerated in this individual patient [3,4,9].

Another important feature was the continuation of HFNC oxygen therapy throughout caesarean delivery. HFNC delivers heated, humidified oxygen at high flow rates and may support oxygenation in selected patients who can maintain spontaneous ventilation [5,6]. In this patient, HFNC was maintained at 45 L/min with an FiO_2 of 0.75 during surgery, without an increase in oxygen requirements or worsening of dyspnoea. However, HFNC does not guarantee adequate alveolar ventilation or protect against aspiration. Its use in a patient with severe respiratory compromise therefore requires close monitoring, immediate access to airway management equipment, and a clearly defined plan for escalation of respiratory support if clinical deterioration occurs [5,6]. The successful completion of surgery in this case illustrates the feasibility of maintaining HFNC during neuraxial anaesthesia in a carefully selected patient, rather than establishing its general safety in patients with acute respiratory failure.

Postoperative care is particularly important in patients with CF because secretion retention and ineffective airway clearance may contribute to further respiratory deterioration [1,2]. Adequate analgesia facilitates coughing, chest physiotherapy, airway clearance, and early mobilisation. Multimodal analgesia, combining regional techniques with non-opioid analgesics, can reduce the need for systemic opioids and their associated adverse effects [12]. Opioids should be used judiciously in patients with limited respiratory reserve because of the potential for sedation and respiratory depression. Careful monitoring is particularly important when neuraxial opioids are administered; however, recommendations developed specifically for neuraxial morphine should not be directly extrapolated to intrathecal sufentanil [13]. In this case, postoperative analgesia consisted of 0.2% epidural ropivacaine administered in 6-mL boluses as needed during the first two postoperative days, alongside scheduled paracetamol and ketorolac. The epidural catheter was removed on postoperative day three. Continued ICU monitoring was appropriate given the patient's advanced pulmonary disease, acute respiratory exacerbation, and substantial perioperative oxygen requirements.

The postoperative course was characterised by progressive respiratory improvement. Four hours after caesarean delivery, the FiO_2 delivered through HFNC was reduced from 0.75 to 0.50, while the flow rate remained at 45 L/min. Respiratory support was subsequently weaned over five days, allowing transition to conventional nasal cannula oxygen at 3 L/min, followed by discharge on postoperative day seven without supplemental oxygen. Although this favourable outcome cannot be attributed solely to the anaesthetic technique, caesarean delivery was completed without reported intraoperative respiratory deterioration or the need for invasive ventilation. The outcome occurred in the context of concurrent antimicrobial treatment, respiratory support, and multidisciplinary perioperative care.

This case illustrates the feasibility of an individualised anaesthetic strategy for urgent caesarean delivery in

a carefully selected parturient with advanced CF and acute hypoxaemic respiratory failure. CSE anaesthesia allowed epidural supplementation of an initially inadequate spinal block while HFNC was maintained and preparations for possible conversion to general anaesthesia remained in place. However, as this is a single case, the relative contributions of the anaesthetic technique, respiratory support, antimicrobial treatment, and multidisciplinary care to the favourable outcome cannot be determined. These findings should therefore be interpreted as a description of an individualised management strategy rather than evidence of its general safety or superiority over alternative approaches.

Conclusions

This case illustrates the feasibility of an individualised CSE anaesthetic approach for urgent caesarean delivery in a parturient with advanced cystic fibrosis and acute hypoxaemic respiratory failure requiring HFNC support. The procedure was successfully completed without intraoperative respiratory deterioration, significant haemodynamic instability, or the need for conversion to general anaesthesia. The successful outcome in this carefully selected patient should not be interpreted as evidence of the general safety or applicability of CSE anaesthesia in all pregnant patients with advanced cystic fibrosis or severe respiratory failure. Anaesthetic management in these circumstances requires individualised risk assessment, multidisciplinary decision-making, careful monitoring, and preparation for potential conversion to general anaesthesia. Furthermore, the favourable postoperative respiratory recovery cannot be attributed solely to the anaesthetic technique, as it occurred in the context of ongoing antimicrobial treatment, respiratory support, and intensive care management.

This case adds to the limited literature describing neuraxial anaesthesia for caesarean delivery in patients with advanced cystic fibrosis and highlights the importance of tailoring anaesthetic management to the patient's clinical condition and available resources.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Débora Marques, José Vicetro, Patrícia Viana

Acquisition, analysis, or interpretation of data: Débora Marques, José Vicetro

Drafting of the manuscript: Débora Marques, José Vicetro

Critical review of the manuscript for important intellectual content: Débora Marques, José Vicetro, Patrícia Viana

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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Débora Marques and José Vicetro contributed equally to the work and should be considered co-first authors.

References

1. Jain R, Kazmerski TM, Zuckerwise LC, et al.: Pregnancy in cystic fibrosis: review of the literature and expert recommendations. J Cyst Fibros. 2022, 21:387-95. 10.1016/j.jcf.2021.07.019
2. Montemayor K, Tullis E, Jain R, Taylor-Cousar JL: Management of pregnancy in cystic fibrosis . Breathe (Sheff). 2022, 18:220005. 10.1183/20734735.0005-2022
3. Deighan M, Ash S, McMorrow R: Anaesthesia for parturients with severe cystic fibrosis: a case series . Int J Obstet Anesth. 2014, 23:75-9. 10.1016/j.ijoa.2013.10.006
4. Pham R, Mehdizadeh C, Baker C, Soloniuk LJ, Pasca I, Sinha A: Anesthetic management and considerations for cesarean delivery in a patient with cystic fibrosis. Case Rep Anesthesiol. 2025, 2025:6388254. 10.1155/cria/6388254
5. Leone M, Einav S, Chiumello D, et al.: Noninvasive respiratory support in the hypoxaemic peri-operative/periprocedural patient: a joint ESA/ESICM guideline. Intensive Care Med. 2020, 46:697-713.

10.1007/s00134-020-05948-0

6. Al-Husinat L, Jouryyeh B, Rawashdeh A, et al.: High-flow oxygen therapy in the perioperative setting and procedural sedation: a review of current evidence. J Clin Med. 2023, 12: 10.3390/jcm12206685
7. Cameron AJ, Skinner TA: Management of a parturient with respiratory failure secondary to cystic fibrosis . Anaesthesia. 2005, 60:77-80. 10.1111/j.1365-2044.2004.03973.x
8. Costello J, Lynch J, Byrne P, Browne G: Pregnancy and cystic fibrosis. Ir Med J. 2008, 101:254-5.
9. Franklin Dos Santos T, Rabassa A, Aljure O, Zbeidy R: Perioperative management and preemptive ECMO cannulation of a parturient with cystic fibrosis undergoing cesarean delivery. Case Rep Anesthesiol. 2020, 2020:8814729. 10.1155/2020/8814729
10. AP V: A proposal for a new method of evaluation of the newborn infant . Curr Res Anesth Analg. 1953, 32:260-7.
11. LoMauro A, Aliverti A: Respiratory physiology of pregnancy: physiology masterclass . Breathe (Sheff). 2015, 11:297-301. 10.1183/20734735.008615
12. Roofthooft E, Joshi GP, Rawal N, Van de Velde M: PROSPECT guideline for elective caesarean section: updated systematic review and procedure-specific postoperative pain management recommendations. Anaesthesia. 2021, 76:665-80. 10.1111/anae.15339
13. Bauchat JR, Weiniger CF, Sultan P, et al.: Society for Obstetric Anesthesia and Perinatology consensus statement: monitoring recommendations for prevention and detection of respiratory depression associated with administration of neuraxial morphine for cesarean delivery analgesia. Anesth Analg. 2019, 129:458-74. 10.1213/ANE.0000000000004195