

Supplementary Information

Supplementary Table 1. Overview of perinatal anesthesia techniques and their clinical applications

Anesthesia techniques	Areas of application	Clinical advantages	Potential risks/limitations	Development trends/innovative directions	References
Intrathecal Morphine (ITM) analgesia	Postoperative analgesia following cesarean section	Improves obstetric recovery, reduces opioid consumption	Opioid-related side effects, requires monitoring	Optimizing maternal recovery in multimodal analgesia strategies	[1]
Combined Spinal-Epidural Anesthesia (CSEA) vs Continuous Epidural Anesthesia (CEA) (Ropivacaine+Sufentanil)	Labor analgesia	Rapid onset, significant pain relief, high satisfaction	Higher adverse reactions with CEA, requires skilled operation CEA	Clinical promotion and optimization of application	[2]
CSEA	Labor analgesia for natural childbirth	Reduces anxiety, significant pain relief, low stress response	Low risk of motor blockade, fewer complications	Improving pain relief safety and optimizing application	[3]
CSEA+acupoint injection	Labor analgesia	Significant pain relief, reduced medication usage	Hypotension, nausea, vomiting, and other adverse events require monitoring	Combination technique to optimize maternal-fetal inflammatory response	[4]
Dural Puncture Epidural (DPE) anesthesia	Cesarean section analgesia	Cesarean section analgesia	Rapid onset, excellent blockade, high satisfaction	Risk of hypotension and intraoperative pain requires monitoring	[5]
CSEA	Labor analgesia	Effective pain relief, controlled induction time	Increased incidence of numbness in the lateral position, increased demand for ephedrine	Optimize positioning to reduce complications	[6]
CSE anesthesia	Labor analgesia	Rapid onset, high safety	Slight increase in maternal uterine artery resistance, fetal heart rate monitoring required	Safe analgesia strategy with low-dose local anesthetics and precise monitoring	[7]
Combined subarachnoid-epidural anesthesia	Labor analgesia	Rapid onset of pain relief, high safety	Increases the risk of maternal fever during labor	Develop predictive models for early identification of high-risk parturients	[8]
Patient-Controlled Epidural Analgesia (PCEA) (Ropivacaine)	Labor analgesia	Effective pain relief, high satisfaction	Frequent pain breakthrough with low concentration	Optimize concentration and dosage regimen	[9]
PIEB+PCEA	Labor analgesia	Reduced intervention, high satisfaction	No significant increase in adverse events	Reduce medical interventions, optimize drug administration	[10]
PIEB epidural analgesia	Labor analgesia	Significant pain relief, low breakthrough pain	Prolonged second stage of labor	Optimize bolus volume and individualized dosing	[11]
DPE epidural anesthesia	Labor analgesia	Good pain relief for breakthrough pain	Experience-dependent, high technical requirements	Enhance analgesia precision and effectiveness	[12]
PIEB+PCEA	Labor analgesia	Reduced drug dosage	Increased staff workload	Optimize the balance between analgesia and workload	[13]
CSE (low-dose ropivacaine - sufentanil)	Labor analgesia	Rapid onset, significant pain relief, low demand for supplemental analgesia	Spinal opioid dose-related adverse reactions	Optimize analgesia, reduce breakthrough pain, multi-center validation	[14]
ClearSight guided Goal-Directed Fluid Therapy (GDFT)	Spinal anesthesia for cesarean section	Reduces nausea	Does not improve hypotension	Optimize fluid management strategies	[15]

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