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Obstetrics & Gynecology

VOLUME 12

Dasgupta's Recent Advances in Obstetrics and Gynecology

Editor
Nandita Palshetkar

Co-Editors
Pratik Tambe
Rohan Palshetkar

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CHAPTER

9 Neonatal Resuscitation

Parmarth Chandane, Deepali Kale, Alpa Bhosale

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INTRODUCTION

It is estimated that approximately 10% of newly born infants need help to begin breathing at birth, and approximately 1% need intensive resuscitative measures to restore cardiorespiratory function. As per the latest data, the current neonatal mortality rate in India is 22 per 1,000 live births. The inability of newly born infants to establish and sustain adequate or spontaneous respiration contributes significantly to these early deaths and the burden of adverse neurodevelopmental outcomes among survivors. Effective and timely resuscitation at birth could therefore improve neonatal outcomes further.[1]

A large number of antepartum and intrapartum maternal conditions carry an increased risk of intrapartum asphyxia. The primary goals of respiration, such as initiation and maintenance of adequate ventilation and oxygenation, adequate cardiac output, and tissue perfusion, can be attained more rapidly when the risk factors are identified early, neonatal problems are anticipated, equipment is available, personnel is qualified and available, and a care plan is formulated.

APGAR score: The Apgar score is used to describe a neonate's cardiorespiratory and neurologic condition at birth. The score is not a tool to guide resuscitation or subsequent treatment and does not determine the prognosis of an individual patient.

The Apgar score assigns 0–2 points for each of the five measures of neonatal health (appearance, pulse, grimace, activity, and respiration—**Table 1**). Scores depend on physiologic maturity and birthweight, maternal perinatal therapy, and fetal cardiorespiratory, and neurologic conditions. A score of 7–10 at 5 minutes is considered normal; 4–6, intermediate; and 0–3, low.

There are multiple possible causes of low (0–3) Apgar scores, including severe, chronic problems that have a poor prognosis and acute problems that can be quickly resolved and have a good prognosis. A low Apgar score is a clinical finding and not a diagnosis.[2]

The delivery room should be equipped with all the tools necessary for the successful resuscitation of a newborn of any size or gestational age. The equipment should include a radiant warmer, warmed blankets, a source of oxygen, instruments for visualizing and establishing an airway, a source

TABLE 1: The APGAR score.

Mnemonic	*0 point*	*1 point*	*2 points*
Appearance	Blue or pale	Blue extremities pink body	Body and extremities pink, no cyanosis
Pulse	Absent	<100 beats per minute	>100 beats per minute
Grimace	No response to stimulation, floppy	Grimace on suction or aggressive stimulation	Cry on stimulation
Activity	None	Some flexion of arms and legs	Active flexion against resistance
Respirations	Absent	Weak, irregular and slow	Strong crying

Source: American Academy of Pediatrics and American Heart Association. Textbook of Neonatal Resuscitation, 6th edition. Elk Grove Village, IL: American Academy of Pediatrics and American Heart Association; 2011

of regulated suction, instruments, and supplies for establishing intravenous (IV) access, trays equipped for emergency procedures, and drugs that may be useful in resuscitation.[3]

All hospital personnel involved in attending deliveries, such as obstetricians, pediatricians, anesthetists, resident doctors, and nurses, should complete a neonatal resuscitation program to facilitate early stabilization and resuscitation of newborns.

A pediatrician or neonatologist can rapidly assess a newly born infant by asking the following three questions:[4]

1. Is it a term for gestation?
2. Does the baby have a good tone?
3. Is the baby breathing or crying?

If the answer to all three questions is "yes," the newly born infant may stay with the mother for routine care. Routine care means the infant is dried, placed skin to skin with the mother, and covered with dry linen to maintain a normal temperature. Observation of breathing, activity, and color must be ongoing.

If the answer to any of these assessment questions is "no," the infant should be moved to a radiant warmer to receive one or more of the following four actions in sequence:

1. Initial steps in stabilization (warm and maintain normal temperature, position, clear secretions only if they are copious and/or obstructing the airway, dry, stimulate)
2. Ventilate and oxygenate
3. Initiate chest compressions
4. Administer epinephrine and/or volume

Approximately 60 seconds ("the Golden Minute") are allotted for completing the initial steps, re-evaluating, and beginning ventilation if

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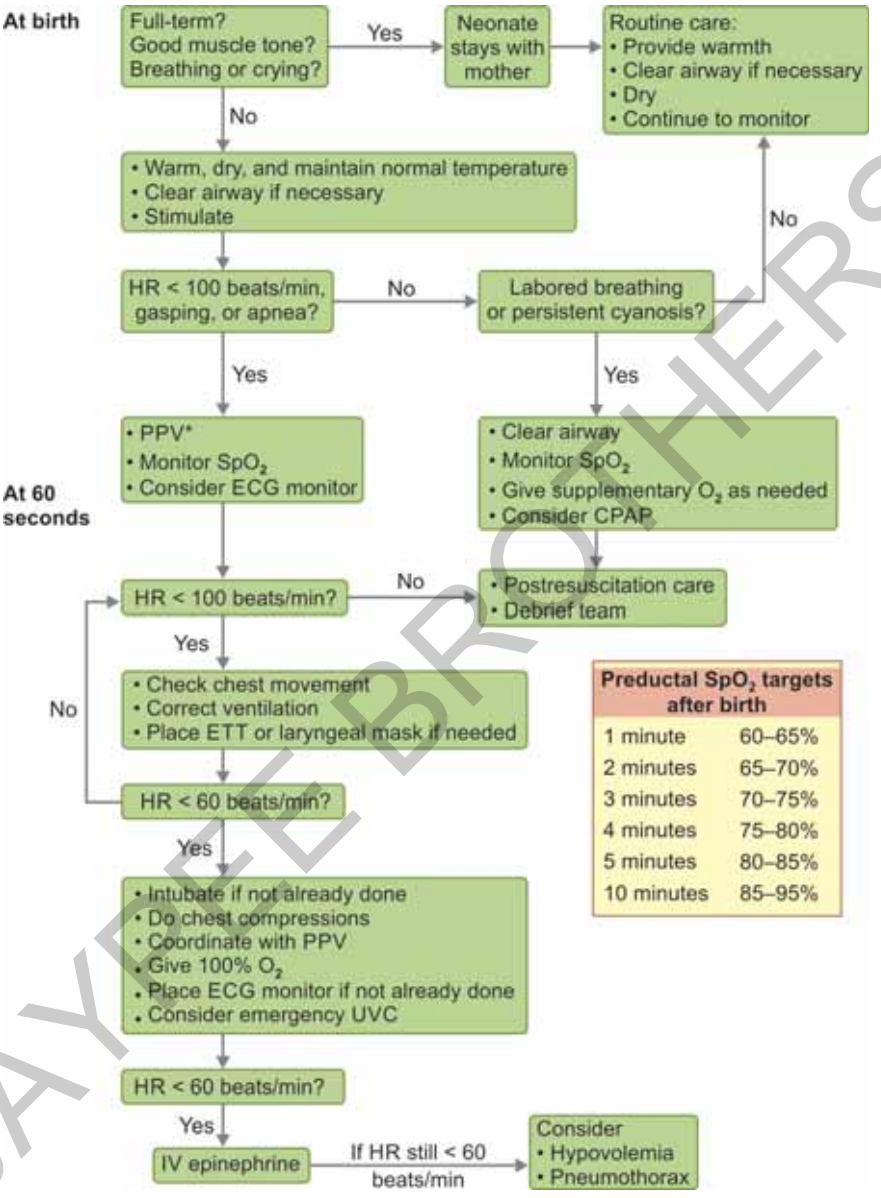
Flowchart 1: Steps of neonatal resuscitation.



(CPAP: continuous positive airway pressure; ETT: endotracheal tube; HR: heart rate; IV: intravenous; PPV: positive-pressure ventilation; UVC: umbilical vein catheter)

required **(Flowchart 1)**. Although the 60-second mark is not precisely defined by science, it is important to avoid unnecessary delay in initiation of ventilation, because this is the most important step for successful resuscitation of the newly born who has not responded to the initial steps.

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The decision to progress beyond the initial steps is determined by simultaneous assessment of two vital characteristics: (1) respirations (apnea, gasping, or labored or unlabored breathing) and (2) heart rate (<100 beats/min). Once positive-pressure ventilation (PPV) or supplementary oxygen administration is started, assessment should consist of simultaneous evaluation of three vital characteristics: (1) heart rate, (2) respiration, and (3) oxygen saturation. The most sensitive indicator of a successful response to each step is an increase in heart rate.[5]

ANTICIPATION OF RESUSCITATION NEED

Anticipation, adequate preparation, accurate evaluation, and prompt initiation of support are critical for successful neonatal resuscitation. At every delivery, there should be at least one person whose primary responsibility is the newly born. This person must be capable of initiating resuscitation, including administration of PPV and chest compressions. With careful consideration of risk factors, the majority of newborns who will need resuscitation can be identified before birth. If the possible need for resuscitation is anticipated, additional skilled personnel should be recruited and the necessary equipment prepared. If a preterm delivery (<37 weeks of gestation) is expected, special preparations will be required. Preterm infants have immature lungs that may be more difficult to ventilate and are also more vulnerable to injury by PPV.

INITIAL STEPS

The initial steps of resuscitation are to provide warmth by placing the infant under a radiant heat source, positioning the head in a "sniffing" position to open the airway, clearing the airway with a bulb syringe or suction catheter, and drying the infant and stimulating breathing.

Very low birth weight (<1,500 g) preterm infants are likely to become hypothermic despite the use of traditional techniques for decreasing heat loss. For this reason, it is recommended that additional warming techniques be used, such as covering the infant in plastic wrap (food-grade, heat-resistant plastic) and placing him or her under radiant heat. The temperature must be monitored closely because of the slight but described risk of hyperthermia with this technique.

Clearing of Airway Meconium

A vigorous infant is defined as one who has strong respiratory efforts, good muscle tone, and a heart rate of 100 beats/min. Endotracheal suctioning for infants who are not vigorous should be performed immediately after birth.

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Periodic Evaluation at a 30-minute Interval and Supplemental Oxygen

Supplementary oxygen is recommended whenever PPV is indicated for resuscitation; free-flow oxygen should be administered to infants who are breathing but have central cyanosis. The standard approach to resuscitation is to use 100% oxygen. Pulse oximetry may guide the use of supplemental oxygen.

Positive-pressure Ventilation

If the infant remains apneic or gasping, if the heart rate remains <100 beats/min 30 seconds after administering the initial steps, or if the infant continues to have persistent central cyanosis despite administration of supplementary oxygen, start PPV.

Endotracheal Tube Placement

Endotracheal intubation may be indicated at several points during neonatal resuscitation:

- When tracheal suctioning for meconium is required.
- If bag-mask ventilation is ineffective or prolonged.
- When chest compressions are performed.
- When endotracheal administration of medications is desired.
- For special resuscitation circumstances, such as congenital diaphragmatic hernia or extremely low birth weight (<1,000 g).

Endotracheal tube placement must be assessed visually during intubation and by confirmatory methods after intubation if the heart rate remains low and is not rising. Except for intubation to remove meconium, exhaled CO_2 detection is the recommended method of confirmation.

Chest Compressions

Chest compressions are indicated for a heart rate that is 60 beats/min despite adequate ventilation with supplementary oxygen for 30 seconds. Because ventilation is the most effective action in neonatal resuscitation and because chest compressions are likely to compete with effective ventilation, rescuers should ensure that assisted ventilation is being delivered optimally before starting chest compressions.

Compressions should be delivered on the lower third of the sternum to a depth of approximately one-third of the anterior-posterior diameter of the chest. Two techniques have been described: (1) Compression with two thumbs with fingers encircling the chest and supporting the back (the two thumb-encircling hands technique) or (2) compression with two fingers with a second hand supporting the back. Because the two thumb-encircling

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hands technique may generate higher peak systolic and coronary perfusion pressure than the two-finger technique, the two thumb-encircling hands technique is recommended for performing chest compressions in newly born infants.

The suggested ratio is three chest compressions synchronized to one inflation (with 30 inflations per minute and 90 compressions per minute) using the two thumb-encircling hands technique for chest compressions.

Vascular Access

When vascular access is required in the newly born, the umbilical venous route is preferred. When IV access is not feasible, the intraosseous route may be considered.

Medications

If the heart rate remains <60 beats/min despite 60 seconds of chest compressions and adequate PPV, epinephrine should be administered, ideally via the IV route.

Volume Expansion

When blood loss is known or suspected based on history and examination, and there is no response to epinephrine, volume expansion is indicated.

Withholding and Discontinuing Resuscitation

It may be possible to identify conditions in which withholding or discontinuation of resuscitative efforts may be reasonably considered by families and care providers. Appropriate and timely support should be provided to all involved.

HUMAN FACTORS AND SYSTEMS

Teams and individuals who provide neonatal resuscitation are faced with many challenges concerning the knowledge, skills, and behaviors needed to perform effectively. Neonatal resuscitation teams may therefore benefit from ongoing booster training, briefing, and debriefing.

Neonatal Resuscitation from the Obstetricians' Point of View

Background

Globally, >7 million children die under 5 years of their lives, and the highest proportion of children dying is during the first 28 days of life. For babies who do not breathe at birth, neonatal resuscitation is critical in reducing intrapartum-related neonatal deaths by 30%.

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Five countries accounted for half of all newborn deaths: (1) India, (2) Pakistan, (3) Nigeria, (4) the Democratic Republic of the Congo, and (5) Ethiopia.[6]

Although neonatal death is multifactorial, the most important causes of newborn death are preterm birth, birth asphyxia, and infection.

Therefore, the need for neonatal resuscitation is most urgent in low-resource settings, where the quality of intrapartum obstetric care is poor and the burden of birth asphyxia-related events is high.

Furthermore, approximately 36% of newborns require basic resuscitation, including stimulation at birth and assisted ventilation with a bag and mask, to help them breathe. This procedure can reduce intrapartum-related neonatal deaths by 30%.[7-11]

Children who die within the first 28 days of birth suffer from conditions and diseases associated with a lack of quality care at birth and treatment immediately and during the first days of life.[12] For babies, who do not breathe at birth, neonatal resuscitation is crucial and might also include prevention and management of meconium aspiration syndrome.[13]

Improving the quality of neonatal resuscitation (NR) techniques is therefore critical in lowering early neonatal deaths and, by extension, the infant mortality rate in developing countries.[14]

Factors Associated with the Provision of Neonatal Resuscitation[14]

- Cadre of professionals
- Work experience
- Age of the provider
- The facility has a separate newborn corner room.
- Separate newborn intensive care unit (NICU), newborn care staff rotation policy, and facility type
- *Facility location*:
  - The operating company
  - Providers trained in neonatal resuscitation
  - Availability of neonatal resuscitation guidelines
  - Infrastructure components and the availability of essential equipment are associated with the practice of neonatal resuscitation.

Basic Characteristics to Ensure Mother-side Neonatal Resuscitation (Table 2)

- A stable, flat, soft, but firm surface on which to place the neonate during resuscitation
- Warming equipment to prevent hypothermia. Preterm babies are placed in a polythene bag while under the radiant heater are usually able to maintain their body temperature.

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TABLE 2: Keywords related to neonatal resuscitation.

Anticipation	*The likelihood of neonatal resuscitation is needed*: Cord accidents, antepartum hemorrhage, prolonged rupture of membranes, maternal infections, assisted vaginal birth, operative delivery, fetal congenital anomalies such as congenital diaphragmatic hernia
Preparation	• Obstetric team must have equipment checked for appropriate functioning • *The temperature warmer*: Pulse oximeter, laryngoscope, endotracheal tubes, bag and mask, neonatal stethoscope, a clean flat sterile surface, a warm towel, sterile cord clamps, oxygen flowmeter, tubes and mask or nasal prongs, suction apparatus
Help	• The communication with the neonatal team should be precise • The hierarchical order of competent neonatologists should be ensured to effect resuscitation in the case of high-risk births
Record	• Documentation of the decision to deliver at a specific time in the event of fetal distress in the form of CTG strips • Documentation of meconium stained liquor, i.e., time when MSAF is detected, quality or grade of MSAF, maternal resuscitation measures such as IV fluids, nasal oxygen, continuous CTG is recommended in the case of MSAF in an advanced stage of labor awaiting spontaneous progress
Fast	Triaging the situation obstetric such as urgent, semiurgent, and electives may help to facilitate the obstetric and neonatal team for proper preparation for resuscitation of the neonate
Gentle	• The newborn must be handled with extreme gentleness • Vigorous patting or hitting on the back by untrained individuals should be avoided
Warmth	Maintenance of the temperature of the neonatal recitation area is crucial for the prevention of hypothermia. The sterile surface of the resuscitation area and the team members using appropriate aseptic precautions are vital
Mother	• Mother should be informed before any decision on delivery for fetal distress in a calm and composed manner. The mode of delivery at the stage of labor, as well as the justification for the mode of delivery via the specific route, should be communicated to the mother and her next of kin • Debriefing must be done after the delivery as per the neonatal status • This ensures that the mother does not suffer the mental trauma which may be caused due to the chaotic situation created by the level of urgency of the delivery

(CTG: cardiotocography; IV: intravenous; MSAF: meconium-stained amniotic fluid)

- Good lighting
- All the equipment to provide PPV with positive end-expiratory immediately and easily available. The neonatologist can personally

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adjust the settings and oxygen levels if necessary. Suction is available. Other accessory equipment may be available in store compartments.
- Monitoring equipment is available or accessible on or immediately near the trolley.
- Easy access to the trolley allows a team to provide resuscitation.

Care after resuscitation
- Make skin-to-skin contact between the baby and the mother
- Keep the baby warm
- Monitor every 15 minutes
- Start breastfeeding as soon as possible
- Discuss what has happened with the parents; be positive!
- Do not separate the mother and baby unless the baby has difficulty in breathing.

Pandemic COVID-19 and the Effects of Neonatal Resuscitation[15]

- Since maternity and newborn care units vary in physical configuration, each facility should consider their appropriate space and staffing needs to prevent transmission of the virus that causes COVID-19.
- These considerations include appropriate isolation of pregnant patients who have suspected or confirmed COVID-19; basic and refresher training for all healthcare personnel on those units to include correct adherence to infection control practices and personal protective equipment (PPE) use and handling; and sufficient and appropriate PPE supplies positioned at all points of care.
- These considerations are based upon the limited evidence available to date about transmission of the virus that causes COVID-19.

CONCLUSION

One-tenth of newborns require some form of assistance to breathe after birth. This need should be anticipated and proper resuscitation should be initiated in time to prevent hypoxic brain injury and death. A standardized equipment checklist is a comprehensive list of critical supplies and equipment needed in a given clinical setting. A predelivery team briefing should be done for successful team management.

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Dasgupta's Recent Advances in Obstetrics and Gynecology-12

The *Recent Advances in Obstetrics and Gynecology* is scheduled to be the third volume in an ongoing series, which seeks to address a much-felt lacuna in postgraduate teaching. Aimed primarily at postgraduate students and residents, this book is a collection of focused articles from much sought after teachers and authors who bring decades of experience and expertise in their respective fields.

Typically, students only receive a short period of study leave prior to the examinations during which, precious time is lost scouring for resources and locating updated guidelines, research papers and evidence on topics of thematic interest. Hence, the authors address this paucity with this textbook series, which aims to unite senior, respected and stalwart postgraduate teachers from all over India who have been mentors and guides to generations of students. Each chapter focuses on traditional concepts as well as the most modern updated evidence on the issues at hand.

The book will be a useful compendium for postgraduate students and readers who wish to keep themselves updated with the latest evidence.

Nandita Palshetkar MD FCPS FICOG FRCOG (UK) is a Professor Emeritus in Obstetrics and Gynecology, DY Patil School of Medicine, Navi Mumbai, Maharashtra, India. She is the President of Indian Society of Assisted Reproduction (ISAR) (2022) and Association of Maharashtra Obstetric and Gynaecological Societies (AMOGS) (2020–2022). She has also been the President of the Federation of Obstetric and Gynaecological Societies of India (FOGSI), 2019; President of Mumbai Obstetric and Gynaecological Society (MOGS), 2016; Indian Association of Gynaecological Endoscopists (IAGE), 2017; and Maharashtra Chapter of ISAR (MSR) (2016–2018). She is the Founder and Medical Director of Bloom IVF heading 10 IVF centers all over India. Widely considered the pioneer in ART and responsible for offering the latest laboratory advances in the field to Indian patients, her passion for medicine in general and assisted reproduction in particular is well known. She has delivered over 65 orations and given several talks at national and international conferences. She has written over 100 textbook chapters, edited several books and published papers in national and international journals. She has received 18 national and international awards including the Bharat Gaurav Award at the House of Commons in the UK. Most recently, she has been conferred the Fellowship of the Royal College of Obstetricians and Gynaecologists (RCOG) for her work towards the upliftment of women's health.

Pratik Tambe MD FICOG is an ART Consultant and Gynec Endoscopic Surgeon. He holds a Diploma in Advanced Laparoscopic Surgery from France and has trained in Assisted Reproduction in Belgium and Clinical Embryology in the UK and Singapore. He is currently Chair, AMOGS Endocrinology Committee and a Managing Council Member of the Mumbai Obs/Gyn Society (MOGS); Indian Society for Assisted Reproduction (ISAR); Maharashtra Chapter of ISAR (MSR); and the Indian College of Obstetricians and Gynaecologists (ICOG). He has also served as the Chair, FOGSI Endocrinology Committee. Besides being a peer-reviewer for the Journal of Obstetrics and Gynaecology of India (JOGI), he has edited 10 books, 3 FOGSI Focuses and Handbooks, 11 Key Practice Points, several series of newsletters and contributed over 75 chapters to several publications countrywide. He is a sought after speaker, invited faculty to 1000+ events and has personally organized over 700 CMEs nationwide. He has been a recipient of 16 MOGS, 8 FOGSI Prizes and Awards and 9 best scientific paper presentation prizes including the MOGS Dr NA Purandare Prize, MOGS Dr SD Upasani Prize (twice), MOGS Dr Duru Shah Best Committee Member Award (five times), FOGSI Dr CS Dawn Prize, FOGSI Dr Kumud Tamaskar Best Thesis Prize, FOGSI Dr Nimish Shelat Research Award, the FOGSI Best Publication Award (twice) and the FOGSI Dr Mehroo Hansotia Best Committee Award 2019.

Rohan Palshetkar MS (Obs & Gyne) FRM is an Obstetrician and Gynecologist with a special interest in ART and High. He is an Associate Professor at DY Patil Medical College and is also the Unit Head of DY Patil Bloom IVF and Opera House Bloom IVF. He is currently the 2nd Joint Secretary of All Maharashtra Association of Obstetrical and Gynaecological Societies; Joint Treasurer of Maharashtra Chapter of IAGE; Managing Committee Member of ISAR; Maharashtra Chapter of ISAR (MSR); and Mumbai Obstetric and Gynaecological Society (MOGS). He has delivered the ISAR Yuva Oration and has been selected for the FOGSI Kamini Rao Yuva Oration for the year 2020 and also received the FOGSI Future Award. Besides this, he has delivered several talks at national and international conferences and has published papers in national and international journals. He is the recipient of the Asia Oceania Federation of Obstetrics and Gynaecology Young Gynaecologist Award. He has won the prestigious FOGSI Movicol (CORION), Shanti Yadav Award, Kumud Tamaskar and Praveen Mehta Awards for his research papers. He has also won the best MOGS Managing Committee member and MOGS Youth Council Member Award.

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