

# Hearing Loss in Children With Respiratory Distress Syndrome

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## Abstract

Respiratory distress syndrome (RDS), also known as hyaline membrane disease, is a lung disease, which is the most common respiratory disease in babies born prematurely. It is caused when an infant does not produce enough surfactant, leading to collapsing of the lungs and low lung volumes. Treatment for RDS includes oxygen therapy, high frequency jet ventilation, mechanical ventilation, or a nasal continuous airway pressure machine. Further treatments such as extracorporeal membrane oxygenation are used if necessary. Respiratory distress syndrome can lead to further complications such as severe neonatal respiratory failure, lung disease and infections. Several studies have shown the effects of hearing loss in infants with respiratory distress syndrome. The type of hearing loss has shown to be consistently a sloping, sensorineural hearing loss, with hearing thresholds poorer in the higher frequencies, that is either progressive or late onset in nature. Infants with RDS are at a higher risk of acquiring a hearing impairment due to the extended risk factors that these infants face. Therefore, it is important that screening for hearing loss in this population throughout development, is stressed. It is important that physicians and parents are aware that the child's hearing should be monitored.

## Incidence of Hearing Loss in Babies Treated for RDS

A review of the literature indicates the following (see Table 1):

- Pourarian et al (2012) reported that 17% of infants treated with oxygen therapy had a hearing loss
- Konkle & Knightly (1993) reported that in two infants who were placed on high frequency jet ventilation, both patients were diagnosed with a severe-to-profound sensorineural hearing loss at 2.5 years old, where the onset and progression of the hearing loss was unknown
- Rastogi et al., (2013) demonstrated that in neonates who received nasal continuous airway pressure machine (NCPAP) and mechanical ventilation, 45% had a confirmed hearing loss after two years, where 17% initially failed the newborn hearing screening

## Severe Respiratory Failure Complications

Implications regarding the likelihood of hearing loss are more significant when severe respiratory failure occurs (see Table 2):

- Pourarian et al., (2012) report that RDS can also lead to severe neonatal respiratory failure
- In survivors of severe neonatal respiratory failure, 53% were reported to have a sensorineural hearing loss, where a high frequency hearing loss occurred in 65%, and 60% showed to have a progressive loss between two to four years old (Pourarian, et al., 2012)
- In a study by Satterfield (1997), in patients who received extracorporeal membrane oxygenation (ECMO), 25.5% were diagnosed with a sensorineural hearing loss with a moderate-to-sever sloping loss being the most prevalent, where 90% had normal hearing at the initial screening
- In another study of patients who received ECMO, 16.7% were diagnosed with a hearing loss after discharge of the NICU, where 77% passed the initial newborn hearing screening (Lasky, et al., 1998)
- In patients who received mechanical ventilation for severe neonatal respiratory failure, 64% were diagnosed with a sensorineural hearing loss, and 88.9% of those passed their initial hearing screening (Satterfield, 1997); the hearing loss was consistently a bilateral sloping hearing loss
- In a study by Fligor et al., (2005), 25% of ECMO graduates reported having a sensorineural hearing loss (Fligor, Neault, Mullen, Feldman, & Jones, 2005); 72% percent of the hearing loss was progressive, and 48% was a delayed onset

Table 1

Results by Author and Year, Type of Treatment, Incidence of Hearing Loss, Type of Hearing Loss, and Important Things to Consider

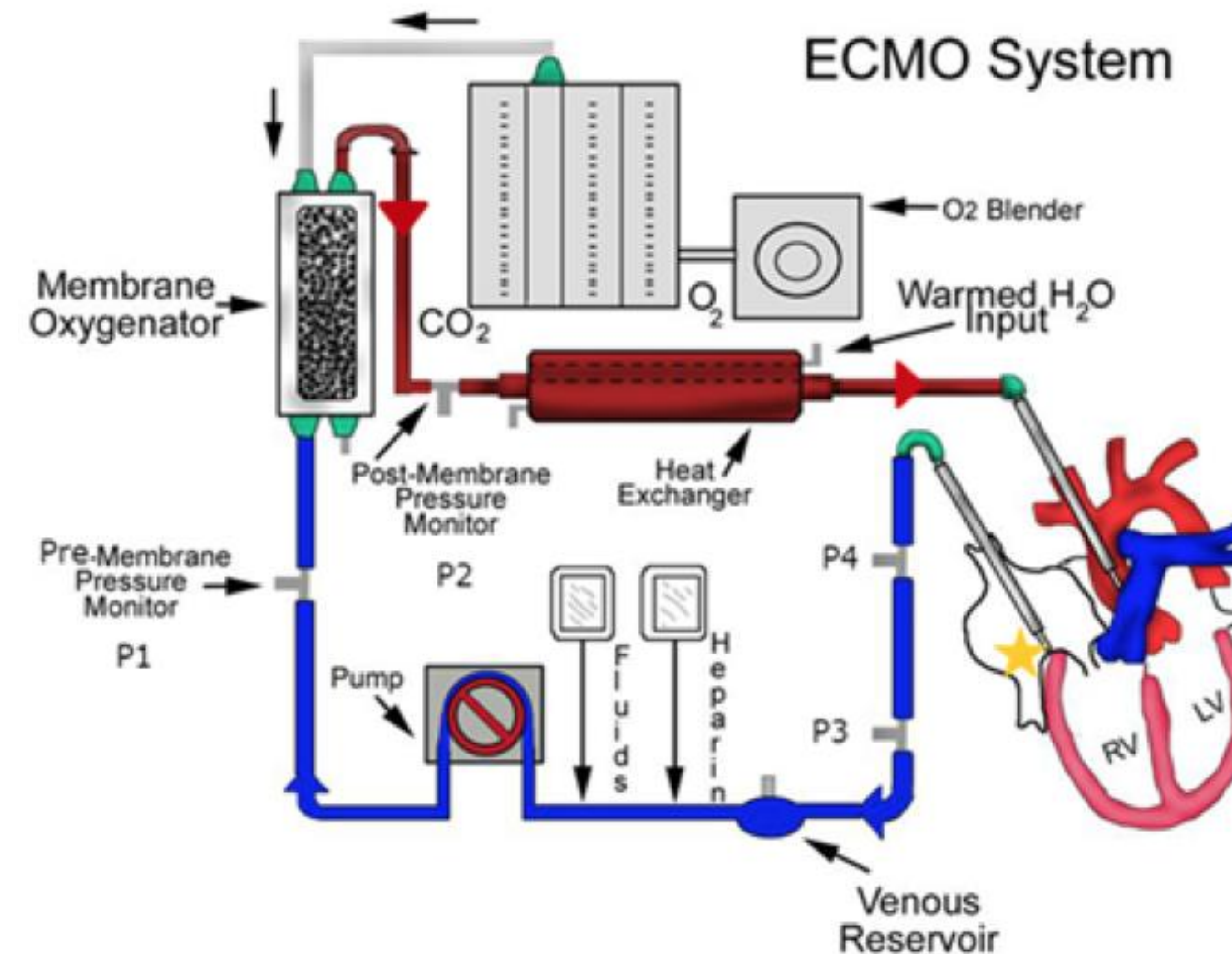
Author, Year	Type of Treatment	Incidence of Hearing loss	Type of Hearing Loss	Important Things to Consider
Konkle & Knightly, 1993	High frequency jet ventilation	100%	Severe-to-profound sensorineural hearing loss	Onset and progression is unknown
Pourarian, Khademi, Pishva, & Jamali, 2012	Oxygen therapy	17%	Not reported	Onset and progression is unknown
Rastogi, Mikhael, Filipov, & Rastogi, 2013	Nasal continuous airway pressure machine (NCPAP) and mechanical ventilation	45%	Not reported	83% passed the newborn hearing screening

Table 2

Results by Author and Year, Treatment/Population, Incidence of Hearing Loss, Type of Hearing Loss, and Important Things to Consider

Author and Year	Treatment/Population	Incidence of Hearing Loss	Type of Hearing loss	Important Things to Consider
Fligor, Neault, Mullen, Feldman, & Jones, 2005	ECMO	25%	<ul style="list-style-type: none"> <li>• Sensorineural</li> <li>• 72% progressive</li> <li>• 48% delayed onset</li> </ul>	Not reported
Lasky, Wiorek, & Becker, 1998	ECMO	16.7%	<ul style="list-style-type: none"> <li>• Not reported</li> </ul>	77% passed the initial newborn hearing screening
Pourarian, Khademi, Pishva, & Jamali, 2012	Survivors of severe neonatal respiratory failure	53%	<ul style="list-style-type: none"> <li>• Sensorineural</li> <li>• 65% had a high frequency loss</li> <li>• 60% showed to have a progressive loss between two to four years old</li> </ul>	Not reported
Satterfield, 1997	ECMO	25.5%	<ul style="list-style-type: none"> <li>• Sensorineural</li> <li>• Most prevalent type was a moderate-to-severe sloping loss</li> </ul>	90% had normal hearing at the initial screening
Satterfield, 1997	Mechanical ventilation	64%	<ul style="list-style-type: none"> <li>• Sensorineural</li> <li>• Bilateral sloping hearing loss</li> </ul>	88.9% of those passed their initial hearing screening

Note: ECMO = extracorporeal membrane oxygenation



## Risk Factors Associated With Hearing Loss

A number of studies have identified risk factors associated with RDS and hearing loss as follows:

- A gestational age of less than 36 weeks and prolonged oxygen therapy (Pourarian, Khademi, et al., 2012)
- The second highest frequency of patients who reported a sensorineural hearing loss, were those subjected to mechanical ventilation for at least five days (Bielecki et al., 2011)
- The probability of sensorineural hearing loss increases with coexisting risk factors included premature birth, low birth weight, and at least a 7 day stay in the NICU (Bielecki, et al., 2011)
- The more time an infant is placed on mechanical ventilation, the greater the likelihood of developing a sensorineural hearing loss is (Satterfield, 1997)

## Clinical Implications

Infants with respiratory distress syndrome are at a higher risk of hearing impairment because of the extended risk factors including prematurity and treatments in the NICU such as mechanical ventilation and oxygen therapy. Because infants who are treated with oxygen and born prematurely are at an exceptional risk for hearing loss, it is especially important that they are monitored of auditory function (Pourarian, et al., 2012). Studies are consistent in showing that infants born with respiratory distress syndrome, regardless of the type of treatment they receive, have a high prevalence of acquiring a hearing loss. Consistently, the type of hearing loss has been sloping, with poorer thresholds in the higher frequencies, either progressive in nature or late onset. It was also shown that a prolonged treatment significantly increased the risk of developing a hearing loss.

- The importance of implementing necessary tests in infants at a high risk of hearing impairment, identifying infants with hearing loss, and administering early treatment, should be stressed
- It is recommended that hearing should be monitored in infants who are diagnosed with respiratory distress syndrome until three years of age (Konkle & Knightly, 1993)
- Due to the consistent findings that majority of the patients in this population pass the initial newborn hearing screening, long term audiologic surveillance in this population is necessary
- Parents should be aware of the risk factors and educated about the increased probability of their child developing a hearing loss later on



## References

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