

**To establish the normal range of SVC blood flow in newborn between gestational age of 34-37 weeks and >37 weeks on life day one**

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**Abstract**

**Background:** Superior vena cava (SVC) blood flow may provide more reliable assessment of neonatal systemic perfusion. Superior vena cava is located in the right anterior superior mediastinum which is formed by the right and left brachiocephalic vein which receives venous blood from brain and upper half of body above diaphragm.

**Methods:** The Present Prospective Cross sectional observational study was conducted in the department of Paediatrics, attached to DR.SN Medical College Jodhpur over the duration of one year .Ethical consent was taken from local institutional ethical committee of Dr.S.N Medical College Jodhpur.

**Results:** In the present study 2D Echocardiography was done in term newborn between gestational ages of 37-41 week with Median gestational age 39 week (range 37-41 week) on life day one. In which mean SVC flow was  $58.89 \pm 19.11$  ml/kg/min. In preterm newborn (Median gestational age 35 week) (range 34-37 week ) on life day one for measurement of superior vena cava

blood flow in which mean flow was  $62.5 \pm 20.93$  ml/kg/min (Mean $\pm$ SD) and Median flow was 57.83ml/kg/min and range of SVC flow was 18-143 ml/kg/min.

**Conclusion:** We conclude that SVC flow measurement through 2D colour Doppler echocardiography is most reliable and non-invasive method in preterm newborn as well as evaluation of treatment.

**Keywords:** SVC, Preterm, Term neonates.

**Introduction**

Preterm newborn are vulnerable to brain injury which is thought to be caused partly by abnormalities in cerebral perfusion <sup>(1)</sup>. Commonly used parameters such as blood pressure & blood lactate level are not sufficient to detect low circulatory blood flow in preterm neonate because these are poor surrogate markers of systemic blood flow during the circulatory transition just after birth <sup>(2)</sup>. Presence of various shunts e.g. PDA & PFO affect the actual measurement of cardiac output. Presence of PFO overestimates the right cardiac output and similarly presence of PDA overestimates the left

ventricular output even up to 100%<sup>(1)</sup>, PDA functionally closes in term newborns within 12-24 hour of life and in preterm newborns closure may be delayed by 3-5 day.

Doppler ultrasonography is an easy and reliable bedside method for measurement of left ventricular output in intensive care setting but this cannot be used for the same purpose in preterm newborns due to the presence of persistence of fetal shunts (PDA and PFO) which do not close immediately after birth<sup>(1,3)</sup>. Generally RVO better reflects systemic blood flow because it is less affected by shunt however turbulence in pulmonary artery from ductal flow can disturb the flow pattern making accurate determination of the right ventricular output difficult<sup>(4)</sup>.

Reliable methods for hemodynamic monitoring plays an important role in identifying underlying pathophysiological processes in critically ill term and preterm newborn and are the prerequisites for selecting adequate therapy. The ideal hemodynamic monitoring system should offer accurate and reproducible measurement of the relevant variables and provide data that can be easily interpreted. It should be easy to use, readily available and should not be operator dependent. It must have a rapid response time, must cause no harm and must be cost-effective. Finally, yet importantly, the monitoring system should provide useful information to guide optimal therapy because such an ideal system does not exist, we have to choose the most appropriate system according to the target population and the clinical problem that has to be solved<sup>(5)</sup>. For this problem, Echocardiographic measurement of superior vena cava (SVC) blood flow may provide more reliable assessment of neonatal systemic perfusion. Superior vena cava is located in the right anterior superior mediastinum which is formed by the right and left

brachiocephalic vein which receives venous blood from brain and upper half of body above diaphragm.<sup>(1)</sup> The flow returning to the heart via the superior vena cava (SVC) is not affected by shunt [PDA & PFO] and represents the 80% of total blood flow from upper part of body,<sup>(1,6)</sup> therefore there is a positive correlation between SVC blood flow & systemic blood flow in early postnatal period in healthy term and preterm newborns on life day one. The SVC flow fulfils the requirements for doppler volumetric measurement, with good windows for both flow velocity and vessel diameter measurements.

### Material And Methods

The Present Prospective Cross sectional observational study was conducted in the department of Paediatrics, attached to DR.SN Medical College Jodhpur over the duration of one year. Ethical consent was taken from local institutional ethical committee of Dr.S.N Medical College Jodhpur.

Written consent was taken from attendant of patient for 2D echocardiography and written consent certificate is attached

A total 100 Newborns were randomly enrolled in our study, out of which 50 were healthy preterm newborn between gestational age of 34-37 week and 50 were healthy term newborn between gestational age of 37-41 weeks which were delivered in the institution in which this study is being conducted. Out of these 59 were male newborn and 41 were female with male to female ratio was (M: F:: 1.4:1). Gestational age was determined by New Ballard score and modified Perkins criteria. Head circumference at birth was measured in all the participated neonate in this study..

Relevant obstetric history was taken and APGAR score / HIE staging was done by modified *Sarnat & Sarnat* staging (without EEG) for each neonates. Birth weight

was taken at the time of study and laboratory parameter like blood sugar and normal temperature were recorded in predesigned performa.

**Inclusive Criteria:** Newborn those delivered intramurally between gestational age 34-37 week and >37 week were included in study group and all were subjected for 2D colour Doppler echocardiography which was done on life day one.

**Exclusion Criteria:** All the Neonates as described below were excluded from our study and following were excluded:

1. Neonates with birth weight <1.5 kg and gestational age <34 week were excluded from study.
2. Those Neonates having APGAR score <7 /HIE staging >1 were excluded from study and
3. Newborns having congenital heart disease were also excluded from the Study
4. Those who were suffering from major congenital anomaly.
5. All those neonates who were on ionotropic support / ventilator support.
6. Newborn who delivered outside of hospital

**Observations**

Present study was conducted in the Department of Paediatrics attached to Dr. S. N. Medical College Jodhpur.

In our study a total 100 healthy newborns were enrolled, out of which 50 newborn were preterm (50%) (Median gestational age 35 weeks) having birth weight ranging from 1.5-2.5 kg with median birth weight was 2200 gm. Whereas remaining 50(50%) newborns were term with gestational age ranging from 37-41 week. (With median Gestational age 39 week) All the Neonates with birth weight 1.5-2.5 and >2.5 kg were studied on life day 1<sup>st</sup> by 2D colour Doppler echocardiography.

Table 1:Sex Wise Distribution of Cases

Sex	Total Number	Percentage
Male	59	59%
Female	41	41%
Total Case	100	100%

In present study total numbers of cases were enrolled 100, out of which 59 male and 41 were female newborn. The Ratio of male to female neonate was 1.4:1.

Table: 2 Gestational Age Wise Distribution Of Cases

Gestational Age	Total number	Percentage
34-37 week	50	50%
>37 week	50	50%
Total number	100	100%

In our study gestational age wise ratio was 1:1 and the median gestational age was 35 week in preterm ( 34-37 week) and in term(37-41 week) median gestational age was 39 week.

Table 3: Superior vena cava blood flow in preterm newborn on life day one.

Parameters	SVC flow (ml/kg/min)
Mean±SD	62.5±20.93
Median	57.83

In present study 2D Echocardiography was done in preterm newborn (Median gestational age 35 week) (range 34-37 week ) on life day one for measurement of superior vena cava blood flow in which mean flow was 62.5±20.93 ml/kg/min (Mean±SD) and Median flow was 57.83ml/kg/min and range of SVC flow was 18-143 ml/kg/min.

Table 4: SVC flow in term newborn on life day one.

Gestational (weeks)	Age	SVC flow (ml/kg/min) Mean±SD
>37		58.89±19.11

In the present study 2D Echocardiography was done in term newborn between gestational ages of 37-41 week with Median gestational age 39 week (range 37-41 week) on life day one. In which mean SVC flow was 58.89±19.11 ml/kg/min.

### Discussion

Improvement in circulatory care in preterm newborns is urgently required because they are more vulnerable to brain injury which is thought to be caused partly by abnormalities in cerebral perfusion<sup>(1)</sup> Commonly used parameters such as blood pressure & blood lactate level are not sufficient to detect low circulatory blood flow in preterm newborn because these are poor surrogate markers of systemic blood flow during the circulatory transition just after birth<sup>(6-8)</sup>. Arterial blood pressure shows little if any association with the volume of systemic blood flow and has an uncertain relationship with the volume of cerebral blood flow.<sup>(5,28,29)</sup> Trials of randomized interventions on the basis of blood pressure thresholds have shown no apparent benefit on long-term outcomes.<sup>(6)</sup>

Echocardiographic measurement of left ventricular output cannot be use as a marker of systemic blood flow because it is confounded by shunt, (eg. PFO, PDA)<sup>(8)</sup>. It has also been shown that shunting across PDA may overestimate the left ventricular output by 100%<sup>(1)</sup>. Right ventricular outflow tract better reflects systemic blood flow because it is less affected by shunt however turbulence in pulmonary artery from ductal flow can disturb the flow pattern making accurate determination of the right ventricular output

difficulty<sup>(4)</sup>. Superior vena cava flow is much better for assessment of systemic blood flow during neonatal period because it is not affected by ductal shunt and also represents, the 80% of total blood flow which is drain from upper part of body & brain<sup>(1,6)</sup>. Superior vena cava is formed by the right and left brachiocephalic vein which receives venous blood from brain and upper half of body above diaphragm. It is located in the right anterior superior mediastinum<sup>(1)</sup>. Echocardiographic estimation of SVC flow can be assessed in the newborns in real time at the bedside, by an appropriately trained personnel without affecting cardiorespiratory status of newborn. Although there is significant variation in the use of targeted neonatal echocardiography at different centers. However it is better to estimate echocardiographic assessment of SVC flow which is most reliable and non-invasive method for assessment of systemic blood flow<sup>(8)</sup>. The validity of Doppler measurement of flow in this vessel is an important issue. The SVC fulfils both requirements for Doppler volumetric measurement of flow, the measurement of velocity with minimal angle of insonation and the determination of vessel diameter<sup>(1)</sup>. Direct validation of this SVC flow in preterm babies would be difficult. However, its validity as a true measure of SVC flow was supported in babies with a closed duct, by a significant correlation between the SVC flow and left ventricular output, these measurement that has been validated, and which is a true representation of systemic blood flow in such babies. In addition, the proportion of left ventricular output represented by SVC flow in these neonate without a ductal shunt was similar to other (adult) human data.<sup>(1)</sup>

The study was conducted in department of Paediatrics in unaid hospital attached to Dr. S.N medical college

Jodhpur. Total 100 cases were enrolled in our study out of which 50 were healthy preterm between gestational age of 34-37 week( median age 35 week ) and 50 were healthy term newborn between gestational age of 37-41 week( median age 39 week) with male to female ratio 1.4:1 in all studies newborns .

2D colour Doppler echocardiography was done in all studies newborn on life day one to establish normal range of SVC flow for assessment of systemic blood flow. We found normal range of SVC flow in preterm 18-143 ml/kg/min and median SVC flow 57.83 ml/kg/min. SVC diameter varies with respiration and to remove this effect, we took an average of diameter of SVC during five to ten cardiac cycles. This was the major strength of our study.

Kluckow M, et al<sup>(1)</sup> assessed SVC flow in newborn >36 week on life day1 and 2 by 2D echocardiography. They found median SVC flow 76 ml/kg/min on day 1 and 93 ml/kg/min on day 2; median intraobserver and interobserver variability were 8.1% and 14%, respectively. In preterm babies with a closed duct, mean SVC flow was 37% of mean left ventricular output. In our study normal range of SVC flow was 18-143 ml/kg/min with median SVC flow 57.83 ml/kg/min.

### Conclusion

We conclude that SVC flow measurement through 2D colour Doppler echocardiography is most reliable and non-invasive method in preterm newborn as well as evaluation of treatment.

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