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Intubation, Surfactant Administration and Extubation (INSURE) to Nasal CPAP in Preterm and Late Preterm Babies, Outcome in Those Babies

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Abstract **Original Research Article**

Respiratory distress syndrome, resulting from a deficiency of surfactant, is the most frequent clinical respiratory disorder in preterm infants. It is the most critical cause of morbidity and mortality in preterm infants. The present study INSURE was done in a total of 100 Preterm neonates who came with respiratory distress syndrome with <35 wks and <1.5kg to NICU, Department of Pediatrics, King George Hospital, Andhra Medical College, Visakhapatnam from January 2018 to July 2019 to know the usefulness of INSURE in a resource-poor setting where the only surfactant is given with NCPAP, where a poorer patient can afford and can decrease the morbidity and mortality of MV. This study concludes that, among spontaneously breathing, premature infants treated with INSURE, decreased the need for subsequent MV by 22%. The higher birth weight, the use of antenatal steroids, the lower RDS score at the time of the procedure, and the early use of surfactant as the good predictors in the INSURE success group. There is a significant decrease in the need for MV in the surfactant group compared to the control group. The reduction in the need for MV decreased the risk of air leak syndrome and is advantageous in medical settings where resources are limited, like in our country.

Keywords: Respiratory distress syndrome, INSURE, Babies, medical settings.

INTRODUCTION

Respiratory distress syndrome, resulting from a deficiency of surfactant, is the most frequent clinical respiratory disorder in preterm infants. It is the most critical cause of morbidity and mortality in preterm infants [1]. Lower the gestational age higher the incidence of RDS, accounting for nearly 80% of incidence in preterm infants with gestational age < 28wks.

Surfactant deficiency results in lower functional capacity, increase work of breathing, and respiratory failure. Mechanical ventilation may induce varying degrees of lung injury with epithelial disruption followed by leakage of the fluid and inflammatory response that can inactivate surfactant [2].

Mechanical ventilation is the single most risk factor in the development of BPD. Intra tracheal exogenous surfactant replacement therapy decreases the mortality, air leak syndrome, following the requirement of ventilatory support, with prophylactic or early surfactant therapy being superior to late rescue therapy in reducing mortality and respiratory morbidity [3, 4].

Continuous positive airway pressure (CPAP) only, without surfactant therapy, has been shown to improve outcomes in infants with RDS [5, 6], However strategies in mild to moderate RDS using CPAP alone ventilation (MV) [7].

The primary purpose of this study is to assess the effectiveness of intratracheal surfactant administered during the progression of RDS followed by extubation and institution of CPAP without mechanical ventilation as a cost-effective treatment.

MATERIALS AND METHODS

Place of study: Newborn babies with respiratory distress admitted to NICU, Department of Pediatrics, King George Hospital, Andhra Medical College, Visakhapatnam.

The number of cases: A total of 100 neonates who came with respiratory distress syndrome with <35

wks and <1.5kg were taken in the study, including both the sex.

Duration of study: The study was conducted from January 2018 to July 2019.

Inclusion criteria: neonates less than 35wks of gestational age & <1.5kgs with RDS admitted to NICU were taken. Features of RDS i) Tachypnea ii) Grunting iii) increase oxygen demand iv) Radiographic findings.

Exclusion criteria: Neonates with APGAR score <2 at 5 min, Congenital malformations, Pneumonia & incompletely treated Pneumothorax, Babies diagnosed with meconium aspiration syndrome.

Study Procedure

All babies, both inborn & outborn, admitted to NICU with gestational age <35wks and <1.5kgs with RDS by clinical (Silverman - Anderson scoring) and radiographic criteria and requiring supplemental oxygen by NCPAP, or by oxygen hood were taken. RDS was defined as clinical respiratory distress in the presence of chest X-ray evidence of lung field granularity, small lung volumes, and air bronchograms.

Informed consent was taken from the parents in written form before doing the procedure. Arterial blood gas analysis was performed before the procedure. It is a case-control study. Infants with surfactant therapy and NCPAP were taken as (surfactant group), and infants to whom parental consent was not given and who came late to the hospital were taken as a control group.

The INSURE (Intubation, Surfactant Administration and Extubation) procedure

Intravenous access was obtained. A loading dose of caffeine citrate 20mg/kg was given at the start of the procedure to prevent apnea. The surfactant group received the required dose of survanta. Correct endotracheal tube placement was assessed clinically & radiologically. Surfactant (4ml/kg) is admitted in four divided aliquots, according to manufacturer's instructions, followed by 5 to 10 minutes of hand ventilation. The infant was extubated and started/restarted on either bubble/ventilator NCPAP. Babies in the control group who did not receive surfactant received the other modalities like NCPAP or MV as required. At 1 to 2 hrs after the intervention, an ABG was performed. Further decisions were made on RDS scoring,spo2, and ABG analysis.The criteria for intubation and MV included with FIO_2 > 50% when O_2 saturation of less than 90%, rising CO_2 retention (pCO_2 > 55 mm of Hg) , (paO_2 <50 mm of Hg) , apnea (> 20 sec) and moderate to severe retractions.

Analysis

The main outcome of the study is to INSURE success, which means not requiring MV, and the failure group, which needed the MV. The outcome in surfactant group and its benefits over only NCPAP (control group) in decreasing the mortality & morbidity that may due to MV Predetermined, secondary outcomes were duration of assisted ventilation, duration on NCPAP, pulmonary hemorrhage, apneic attack, ±-air leak syndromes, and length of stay in the hospital.

Statistical Methods

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean + SD (Min-Max), and results on categorical measurements are presented in Number (%). Significance is assessed at a 5 % level of significance. Student t-test (two-tailed, independent) has been used to find the significance of study parameters on a continuous scale between two groups (Intergroup analysis) on metric parameters. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on a categorical scale between two or more groups.

Statistical Software

The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0, and R environment ver.2.11.1 were used for the analysis of the data.

Observation and Analysis

A total of 100 infants were included in the study. Of these (50 surfactants, 50 control) were taken. The study groups were similar concerning baseline characteristics.

Table-1: Gestational age in two groups studied

Gestational age in weeks	Cases		Controls	
	No	**%**	**No**	**%**
27-29	12	25.0	10	19.4
30 -32	34	66.6	37	75.0
32 - 35	4	8.33	3	5.55
Total	**50**	**100**	**50**	**100.0**
	Mean ± SD =30.36±1.96		Mean ± SD =30.56±1.73	

P = 0.65 (Not significant)

Out of 100 neonates, most of the neonates 34 (66.6%) in the surfactant group and 37 (75.0%) neonates in the control group were between 30wks to 32wks of GA respectively. 12 (25.0%) in the surfactant group and 10(19.4%) in the control group were between.27wks to 29wks of GA respectively. Very less 4 (8.3%) in the study group and 3 (5.5 %) in the control group were between 32wks of GA to 35 wks respectively.

Table-2: ELBW/VLBW in two groups studied

	Cases				**Controls**	
	Insure success		**Insure failure**			
	No	%	No	%	No	%
ELBW	4	16.6	7	27.7	9	16.7
VLBW	21	83.3	18	72.2	41	83.3
	Mean±SD = 1.30±0.20		Mean±SD = 1.19±0.20		Mean±SD=1.22±0.17	
	P = 0.01*				P = 0.59	

The mean birth weight in the Insure success and the failure group were 1.30±0.20 & 1.19±0.20 respectively which is statistically significant. The control group does not show any significant difference with the mean weight being 1.22±0.17. More the birth weight better is the INSURE outcome.

Table 3: Gender distribution of patients studied

Gender	**Cases**		**Controls**	
	No	**%**	**No**	**%**
Female	15	30.6	20	38.9
Male	35	69.4	30	61.1
Total	50	100.0	50	100.0

P=0.458

In our study Males constituted more both in the study group and control group. 35(69.4%) in the surfactant group and 30 (61.1%) in the control group were males.

Out of 50 neonates in the study group in whom 25 were success groups not requiring MV in whom steroids were not given in 3(11.1%) whereas 11(44.4%) received one dose of steroid and 11(44.4%) received two doses of steroid. In the failure group, 12 (50%) did not receive any steroids whereas 7 (27.7%) received one dose of steroids and 6 (22.2%) received two doses of steroids. In the control group, most of them 28 (55.5%) did not receive ant steroids, 15 (30.5%) and 7 (13.8%) received one and two doses respectively. The use of antenatal steroids in the INSURE success and the failure group showed a significant p-value.

The respiratory distress scoring is useful to grade respiratory distress as mild, moderate, and severe. Mild respiratory distress is seen in 22.2% of Insure success group, 11.1% of Insure failure group, and in the control group no one presented with mild RDS. 72.2% in Insure success cases, 66.6% in Insure failure cases, and 75% in control cases presented with moderate RDS. 5.55% in 25 of Insure cases, 22.2% in Insure failure cases, and 25% in the control group presented with severe RDS. The mean RDS score in the success group is 4.50±1.1 & in the failure group is 5.44± 1.1. There is a significant p-value between the success and failure groups and the control group indicating the more severe the score at the time of admission, the more chances of the failure cases requiring ventilator care. In the control group, most of the neonates admitted presented with moderate 75% and 25% with severe RDS.

Table-4: Intervention comparison between surfactant & only NCPAP group

	Cases (n=50)		**Controls (n=50)**		**P value**
	No	**%**	**No**	**%**	
Whether needed CPAP					
No	0	0.0	0	0.0	
Yes	50	100.0	50	100.0	
No. of Hrs after which insure is Performed					
0	0	0.0	50	100.0	
<2	21	41.6	0	0.0	
2-6	26	52.7	0	0.0	
>6	3	5.6	0	0.0	
No. of doses of surfactant					
Normal	0	0.0	50	100.0	
1	47	94.4	0	0.0	
2	3	5.6	0	0.0	

No. of days on CPAP					
<2	20	38.9	26	52.8	0.416
2-4	29	58.3	20	41.7	
>4	1	2.8	4	5.6	
Whether baby needed MV					
No	25	50.0	14	27.7	0.003**
Yes	25	50.0	36	72.3	
No of days on MV					
NO	25	50.0	8	16.7	<0.001**
<2	11	22.2	2	2.77	
2-4	12	25	10	19.4	
>4	2	2.7	30	61.1	

All the neonates in the study group (cases & control group) needed CPAP at the time of admission. The cases received surfactant, in which 47(94.4%) & 3(5.6%) received one and two doses respectively,out of 50 neonates, 25 (50%) of neonates needed MV in the study group while 36 (72.3%) in the control group required MV which is statistically significant. The duration of MV is more in the control group than the surfactant group. 30 (61.1%) in the control group required MV even after 4 days whereas 2 (2.77%) in the surfactant group were on a statistically significant ventilator.

Primary outcome

Table-5: Subsequent ventilation

Need for MV	**CASES**		**CONTROL**	
	No	**%**	**No**	**%**
YES	25	50.0	36	72.2
NO	25	5 0.0	14	27.7
Total	**50**	**100.0**	**50**	**100.0**

P=0.053±, Significant, Chi-Square test

The primary outcome in the study group is the need for subsequent ventilation. 25 (50%) in the surfactant group required MV & 36 (72.3%) in the control group required MV. The use of surfactants decreased the need for MV by 22% in the surfactant group than in a control group. Mortality was seen in 21(41.7%) in the surfactant group & 27 (55.5%) in the control group.

Table-6: Mortality status

DEATH	**Cases**		**Controls**	
	No	**%**	**No**	**%**
No	29	58.3	22	44.4
Yes	21	41.7	28	55.5
Total	50	100.0	50	100.0

P=0.238, not significant, chi-square test

Table-7: No. of hrs INSURE performed

No of hrs insure performed	**Total (N=50)**	**Recovered (N=21/36)**	**Mortality (N=15/36)**
2 hr	21(41.7%)	17(57.1%)	4(20%)
2-6 hr	26(52.8%)	12(42.9%)	14(62.7%)
>6	3(5.6%)	0(0%)	3(13.3%)
Total	**50(100%)**	**29(100%)**	**15(100%)**
P-value		0.032*	0.030*

No of hrs insure performed	**Total (N=36)**	**Babies requiring MV**	**95% CI**
2 hr	21(41.7%)	5(22%)	16.34 - 29.47
2-6 hr	26(52.8%)	17(66.7%)	58.84 - 73.67
>6	3(5.6%)	3(11.1%)	7.07 - 17.10
Total	**50(100%)**	**25(100%)**	

2-6 hrs showed significance based on a 95% confidence interval. In the study group, the time at which the procedure is performed had a relation with its recovery, mortality, and the need for MV. Out of 50 neonates in the surfactant group 21 cases were given surfactant within 2hrs of age in whom 17 cases recovered and 5 required MV in whom 4 cases expired. 36 neonates of the surfactant group received the dose between 2-6 hr of age in whom only 12 cases recovered and 17 needed MV in whom 14 cases expired. In 2 cases that received surfactant dose >6hrs, none survived.

Table-8: Surfactant oxygenation in early Vs late administration

	Early surfactant (<2/2hrs) Mean±SD	Late surfactant (> 2hrs) Mean±SD
Pre surfactant a/A ratio	0.25±0.05	0.18±0.06
Post surfactant a/A ratio	0.38±0.08	0.30± 0.08
P value	0.003*	0.007*

The mean post surfactant a/A ratio in the early surfactant is 0.38±0.08 & the late surfactant is 0.30±0.08 which is significant.

DISCUSSION

Table-9: Gestational age-wise distribution

STUDIES	CASES (Mean±SD)	CONTROLS (Mean±SD)
Our study	30.36±1.9	30.56±1.7
Reininger *et al*.,	32.4±1.9	32.6±2.0
Rojas *et al*.,	29.3±1.4	29.3±1.4
Dani *et al*.,	27.1±2.0	27.6±1.5

In our study, the Mean± SD is 30.36 ± 1.96 for cases and 30.56±1.73 for controls. In the present study most of the babies were between 30 to 32 wk gestational age. The study done by Reininger *et al*., during 2005, wanted to assess, among premature infants with RDS, the effect of one dose of intratracheally administered surfactant followed by extubation to NCPAP on subsequent ventilation compared to NCPAP alone. The study was conducted in NICU at Golisano children's hospital between December 1995 and August 2002. The Mean± SD is 32.4±1.9 & 32.6±2.0 for cases and controls, respectively. In a study done by Rojas *et al*., in Columbia 8 centers participated in this randomized, controlled trial. Infants born between 27 and 31-6⁄7 weeks gestation had evidence of respiratory distress and were randomly assigned within the first hour of life to intubation, immediate surfactant administration, extubation, to nasal continuous positive airway pressure (treatment group) NCPAP alone in (control group). Mean± SD is 29.3±1.4 & 29.3±1.4 respectively. In the study done by Dani *et al*., [8]. in Florence during a period from January 2005 to December 2008 to identify the clinical characteristics which could distinguish infants who can be managed with the INSURE method for preventing MV and which could predict INSURE success or failure. The mean ± SD in his study was 27.1±2.0 for cases and27.6±1.5 for controls. In Reininger *et al*., [9] the mean ±SD in his study was 32.4±1.9 for cases 32.6±2 for controls respectively.

Table-10: Birth weight distribution

BIRTH WEIGHT	CASES (Mean±SD) gm	CONTROLS (Mean±SD) gm
Our study	1300±200	1220±100
Reininger *et al*.,	1853±605	1895±539
Rojas *et al*.,	1299±325	1293±324
Dani *et al*.,	855±249	975±199

Our study showed a mean gestational age of 1300±200 gm in the surfactant group and 1220±100 gm in the control group. This is in comparison with studies like Rojas *et al*. 1299±325 & 1293±324 for cases and controls because the gestational age considered is between 27 -31wks and 25-35 wks which are similar to our study. The other studies took gestational age <30wks and ELBW babies. The mean birth weight between the INSURE success and failure group is statistically significant in our group being1300±200 gm and 1100±200 gm, respectively. In Manizheh Mostafa Gharehbaghi *et al*., also showed that lower the birth weight more the chances of surfactant failure being 1688±472 gm & 1342±545 gm for success and failure, respectively.

Table-11: Gender wise distribution

STUDIES	CASES (Males) (%)	CONTROLS (Males) (%)
Our study	69.4 %	61.1%
Reininger *et al*.,	58%	66%
Manizheh *et al*.,	60.8%	51.1%
Brix *et al*.,	57%	61%

All studies, including our study, males outnumbered females. There is no significant difference found in gender distribution in both cases and controls.

Administration of antenatal steroids

In the study done by Manizheh Mostafa Gharehbaghi *et al*., [10], a prospective descriptive-analytical study conducted in a tertiary level neonatal intensive care unit (NICU) of a referral University Hospital in Tabriz, Iran, between March 2012 and December 2012. , 73.3% in the control group took antenatal steroids. In the study done by Dani *et al*., [8], 93% of control took antenatal steroids. In our study, only 44% in controls took antenatal steroids, which is very less when compared to other studies, which can be attributed that most of the control group cases are extramural, and the antenatal history of receiving steroids could not be recorded. In our study, we got a good outcome for the neonates who received antenatal steroids (72%), with no difference seen between taking one or two doses.

Respiratory distress scoring

The RDS scoring in our study in the INSURE success group is less than the failure group in comparison with the study done by Manizheh Mostafa Gharehbaghi *et al*., [10], where it is 7.1±1.3 & 8.8±1.0 in success and failure groups. The neonates admitted to our NICU had less scoring compared to other studies.

6. Primary outcome

a) NEED for MV

	CASES (%)	CONTROLS (%)
Our study	25(50%)	36(72.2%)
Reininger *et al*.,	26 (50%)	37(70%)
Bohlin *et al*.,	15(19%)	28(38%)
Rojas *et al*.,	37(26%)	53(39%)

In our study, there is a 22.2.% decrease in the need for MV in the surfactant group compared to the control group. This is comparable with other studies like Reininger *et al*[9]., where there was a 20% decrease need for mechanical ventilation in the surfactant group. The study done by Bohlin *et al*[11]a descriptive, retrospective, bi-center survey in Stockholm, Sweden countries, compared mechanical ventilation (MV) rates, surfactant use, treatment response, and its outcome of all inborn infants with gestational age between 27 to 34 weeks and RDS, (n=420), during the 5-year periods before and after the introduction of the INSURE-strategy at one of the centers (Karolinska Huddinge)in 1998. The other center (Karolinska Solna) continued conventional surfactant therapy in addition to MV throughout the study. The study concluded that implementing a strategy of surfactant administration by transient intubation during NCPAP reduces the need for MV without adverse effects on outcome and may be an option to more effectively treat RDS, particularly in a critical care setting where the transfer is necessary to provide MV. In his study, the decrease in need for MV is 19% which is comparable to our study.

All studies conclude that the use of surfactants decreases the need for subsequent ventilation, thereby preventing secondary surfactant deficiency.

b) Mortality

	CASES	CONTROLS
Our study	21 (41.7%)	28 (55.5%)
Dani *et al*.,	7(9%)	14(47%)
Rojas *et al*.,	13(9%)	13(9%)

In the study done by Dani *et al*., [8] mortality is 9% in the surfactant group and 47% in the control group. In the study done by Rojas *et al*., [12] the mortality is is 9% in the surfactant group and 9% in the control group respectively. Infants with insure success group had less severe RDS., less mortality, and shorter duration of stay in the NICU than the infants in the failure group. The mortality in our study is very high when compared to other studies because of delay in the intervention as many of the patients were extramural who came late to the hospital. There was delay in the consent from the parents regarding the surfactant administration as most of the patients were illiterates and belonged to lower socioeconomic status.

Table-12: Timing of surfactant administration with mortality

Mortality	Early surfactant(n=15)	Late surfactant(n=21)
Our study	4(20%)	17(57.1%)
Verder *et al*., 1999	3(9%)	7(26%)

The study was done by verder *et al*., [13] in 1999 to determine whether early versus late treatment with procaine surfactant (curosurf) reduces the requirement of mechanical ventilation in very preterm

infants primarily supported by NCPAP. It concluded that NCPAP, in combination with early curosurf, significantly improves oxygenation and reduces the need for subsequent ventilation in infants <30 wks with RDS. In our study, early surfactant had low mortality when compared to late surfactant administration which is similar when compared to verder *et al*., study of 9% & 26%, respectively.

Table-13: The a/A ratio for oxygenation by ABG analysis

	Pre surfactant (Mean±SD)	Post surfactant (Mean±SD)	Preventilator (Mean±SD)	Post ventilator (Mean±SD)
Our study	0.21±0.06	0.33±0.09	0.25±0.08	0.23±0.09
Reininger *et al*.,	0.34 (0.10-0.84)	0.45(0.10-0.92)	0.40(0.08 -0.86)	0.29(0.08-0.96)
Dani *et al*.,	0.28±0.13	0.47±0.17	0.21±0.14	0.48±0.13

The oxygenation is calculated by the a/A ratio. In our study the (Mean±SD) before and after surfactant administration is 0.21±0.06 & 0.33±0.09 respectively and in Reininger *et al*., it is 0.34 (0.10-0.84) & 0.45(0.10-0.92) respectively. In Dani *et al*. study, it is 0.28±0.13 & 0.47±0.17.In ventilated cases, the a/A ratio before and after ventilation is 0.25±0.08 & 0.23±0.09. In Reininger *et al* study it is 0.40(0.08 - 0.86) & 0.29(0.08-0.96). In Dani *et al*., study it is 0.21±0.14 & 0.48±0.13. The a/A ratio is increased in the surfactant group after administration than the control group in both our study and Reininger *et al*. study. In Dani *et al*., study, they compared surfactant administration with both CPAP and MV, where there is an increase in a/A ratio in pre and post-SUFR-CPAP & SURF-MV groups.

Table-14: The a/A ratio between early Vs. late surfactant

	EARLY		LATE	
	Pre surfactant (Mean±SD)	Post surfactant (Mean±SD)	Pre surfactant (Mean±SD)	Post surfactant (Mean±SD)
Our study	0.25±0.05	0.38±0.08	0.18±0.06	0.23±0.09
Verder *et al*.,	0.28±0.18	0.48±0.18	0.28±0.18	0.36±0.18

The increase in oxygenation in the early surfactant group is more when compared to the late surfactant group in both our study and Verder *et al*., study.

Table-15: Need for MV after 5th day

	CASES	CONTROLS
Our study	2(2.1%)	30 (61.1%)
Nayeri *et al*	5 (23.8%)	14(66.7%)

In 2013 the study was done by Nayeri *et al*., [14] the need for mechanical ventilation was significantly reduced to one-third in the INSURE group. The duration of MV needed in the surfactant group even after the 5th day is 2(2.1%) in our study group and 30 (61.1%) in the control group incomparable with Nayeri *et al*., study where it is 5(23.8%) &14(66.7%) in cases and controls respectively. In the study done by Kandaraju *et al*., [15] in 2012, they randomly assigned babies born at 28 0/7 to 33 6/7 of gestation with RDS and on CPAP within the first 2 hrs of life to early routine surfactant administration by the INSURE technique (early surfactant group) or too late selective administration of surfactant (late surfactant group). The primary outcome studied for need of MV in the first 7days of life. Among 153 infants randomized to the early versus late surfactant group, the need for MV was significantly lower in the early surfactant group (16.2% Vs. 31.6%).

CONCLUSION

This study concludes that, among spontaneously breathing premature infants treated with INSURE technique has decreased the need for subsequent MV. The higher birth weight, the use of antenatal steroids, the lower RDS score at the time of the procedure, and the early use of surfactant are good predictors in the INSURE success group. There is a significant decrease in the need for MV in the surfactant group compared to the control group. The need for MV was decreased, the risk of air leak syndrome was reduced and is advantageous in medical settings where resources are limited, like our country. Use of INSURE technique lessens the requirement of respiratory support and contributes to the decreasing stay in the intensive care unit, which can be a cost-effective treatment.

SUMMARY

The data available from the present study showed that the use of a surfactant decreased the need for MV. It reduced the need for MV by 22% in the surfactant group. There is a 15% decrease in mortality in the surfactant group compared to the control group. The birth weight in the INSURE success group is higher at 1300±200 gms compared to the failure group at 1190±200 gm, which is statistically significant. The use of antenatal steroids showed a significant outcome both in the surfactant group and the control group. 81 % in the surfactant group and 95% in the control group showed mortality who did not receive any antenatal steroids.23% and 9% in cases and controls respectively

received one dose and 25% in cases and 0% in controls who received two doses showed mortality, and it is statistically significant. The respiratory distress scoring at the time of presentation had a significant outcome on mortality. Neonates with a score of >7 showed the highest mortality, like 75% in the surfactant group, and 55% in the control group showed mortality. In our study, we have seen that the higher birth weight, the use of antenatal steroids, the lower RDS score at the time of the procedure, and the early use of surfactant as the good predictors in the INSURE success group. The duration of MV, if needed, is decreased in the surfactant group. Even after the 5th day of admission, 61% in the control group required MV, whereas only 2% in the surfactant group required MV. The significant increase in the oxygenation in the early surfactant than the late surfactant enlightens us for the use of prophylactic surfactant than rescue surfactant. The air-leak syndromes in the surfactant group are less when compared to the control group because of decreased need for the MV, less barotrauma compared to the control group, which is significant. The stay in the NICU decreased in the surfactant group compared to the control group, which can be a cost-effective treatment.

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