LUNG ULTRASOUND SCORE AND DIURETICS IN PRETERM INFANTS BORN BEFORE 32 WEEKS

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Abstract

OBJECTIVE To describe if weekly determined lung ultrasound (LU) scores in preterm infants born before 32 weeks (PTB32W) change with diuretic therapy. DESIGN This is a secondary analysis of a prospective study about weekly performed LU in PTB32W: we included infants who received diuretics, and compared LU scores according to their evolution on respiratory support (RS) before and after diuretics. RESULTS We included 17 PTB32W. Both groups were similar in terms of median gestational age: 26 weeks (interquartile rank (IQR) 25-28) in the responders group, and 27 weeks (IQR 25-29) in the other; but different in median number of days on invasive mechanical ventilation: 27 (IQR 11-43) vs. 76 (IQR 35-117) in the non-responders group, p=0.03; and number of infants with moderate-severe bronchopulmonary dysplasia: 2 (25%) vs. 8 (89%), p=0.005. The responders group showed lower LU scores at one week after diuretics: median LU score 3 (IQR 0-10) vs. 12 (IQR 12-12) in the non-responders group, p=0.04; and after three weeks of treatment: median value 6 (IQR 3-6) in the responders group vs. 12 (10-15) in the non-responders group, p=0.01. The decrease in RS was achieved since the beginning of diuretics: 4 out of 8 (50%) were extubated in the responders group, and 8 out of 9 (11%) in the non-responders group, p=0.048. CONCLUSIONS There is a group of PTB32W whose LU score improves after diuretics. This change appears later than that observed in the RS.

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INTRODUCTION

Lung ultrasound (LU) is proving very useful in Neonatal Intensive Care Units (NICU): it is diagnostic for respiratory diseases with a higher accuracy than X-ray [1–3], predicts the need for admission of neonatal patients [4], non-invasive ventilation failure [5,6], or even the need for surfactant in preterm [7] and very low birth weight infants [8]. It also predicts bronchopulmonary dysplasia (BPD) in very low birth weight infants in the first week of life[9,10]. Therefore, it is a harmless, and easy to learn technique, rendering high intraobserver and interobserver agreement[11]. For all these reasons, it is becoming widely extended in NICUs around the world.

LU score is a semiquantitative value that correlates well with the oxygenation status of neonatal patients [7], and the severity of respiratory diseases [12]. It can be used to monitor progression of lung diseases, and to compare LUs in the same patient. LU detects pulmonary edema better than X-ray[13], and it is helpful to evaluate lung edema in neonates, according to the guidelines on Point of Care Ultrasound for critically ill neonates and children by the European Society of Paediatric and Neonatal Intensive Care [14]. LU score is a real time indicator of extravascular lung water [15], and it also correlates with lung inflammation in preterm neonates[16]. On the other hand, LU scores remain high since birth until 36 weeks' postmenstrual age (PMA) in very low birth weight infants with BPD [10].

Diuretics are often prescribed in preterm infants with established BPD, although there is little evidence to support their long-term efficacy and safety [17]. Different studies have demonstrated that furosemide may improve respiratory function in preterm infants, due to fluid removal from lung tissue [18–20]. Anyway, some studies in BPD patients have failed to show real benefits in these subgroup of preterm infants [21,22], but a more recent one shows a decrease in BPD or death in preterm infants on furosemide[23]. On the other hand, secondary effects due to their long-term use have been described in terms of decreased bone mineralization, hearing loss or nephrotoxicity.

Therefore, we conducted a study with the aim to describe if weekly determined LU scores in preterm infants born before 32 weeks (PTB32W) change with diuretic therapy.

MATERIAL AND METHODS:

Patients

This is a secondary analysis of a prospective study performed in PTB32W. From November 2017 to April 2020, every PTB32W admitted to the NICU at Hospital Puerta del Mar in Cádiz, Spain (inborn or transferred from another hospital in the first 24 hours of life) was recruited with parental consent. Infants with chromosomal abnormalities, major malformations or those who died before 36 weeks' PMA were excluded. The local Ethics Committee approved the study protocol, with the internal number LUS-NEO-17-01. We selected the patients that received diuretics before 36 weeks' PMA, and had more than one LU before and after beginning of treatment. Diuretics recorded were furosemide, hydrochlorothiazide and spironolactone. Diuretics were prescribed by the attending neonatologist, who was not aware of the LU results.

Lung ultrasound

We performed beside LU at birth, at three days, and weekly thereafter until 36 weeks' PMA, and we calculated LU score as previously described in neonatal patients [7] by adding the score (0-3) obtained in three areas of the thorax defined by the anterior axillary line, the posterior axillary line and the mammary line (upper anterior, lower anterior and lateral), with a total range of 0 to 18.

We used a portable ultrasound machine (Sonoscape Medical Corp., Shenzhen, China) with a high-frequency linear 8-15 MHz probe, holding the probe perpendicular to the ribs. All LU were performed by the same neonatologist, and were recorded anonymously.

Groups

We divided the patients in two groups according to their response to diuretics in terms of decreasing respiratory support (RS). We registered RS at the time of each LU, and we categorized it as: invasive mechanical ventilation (IMV), nasal intermittent positive pressure ventilation (NIV), nasal continuous positive airway pressure (nCPAP), high flow nasal cannula (HFNC) and none. As the diuretics' effect in pulmonary function tests have been described to occur as late as four weeks afterwards [21], we compared the highest RS two weeks before LU, with the lowest RS four weeks after LU.

- Responders: the lowest RS four weeks after diuretics is, at least, one level lower than the higher RS two weeks before diuretics. - Non-responders: the lowest RS four weeks after diuretics is the same or worse than the highest RS two weeks before diuretics.

As the time at which infants required diuretics was different, we centered the date of LU in the day when diuretics were started. We created these groups of dates: "32 days or more before diuretics" (B1), "31-24 days before diuretics" (B2), "23-16 days before diuretics" (B3), " 15-8 days before diuretics" (B4), "7-4 days before diuretics" (B5), "3 days before to 1 day after diuretics" (T0), "2 to 5 days after diuretics" (A1), "6 to 9 days after diuretics" (A2), "10 to 17 days after diuretics" (A3), "18 to 25 days after diuretics" (A4), "26 to 33 days after diuretics" (A5), "34 or more days after diuretics" (A6).

BPD was defined according to Walsh et al. definition[24]: mild BPD (oxygen requirement for the first 28 days but in room air at 36 weeks' PMA), moderate BPD (oxygen requirement for the first 28 days and oxygen <30% at 36 weeks' PMA. A room-air challenge was performed in these infants and only those that failed the reduction (oxygen saturation 80-87% for 5 minutes, or <80% for 1 minute) were diagnosed as moderate BPD), and severe BPD (oxygen requirement for the first 28 days and oxygen >30% or continuous positive airway pressure or mechanical ventilation at 36 weeks' PMA).

Statistical analysis

We calculated median and interquartile range (IQR), or absolute numbers and percentages to describe the variables measured. To compare variables between groups, we used Student's T-test or Wilcoxon rank sum test depending on the distribution of the variables, with Bonferroni correction for multiple comparisons. We compared clinical variables, LU scores and RS at the different moments analysed between the two groups.

Differences were considered statistically significant if p<0.05. We used STATA v.14.2 (StataCorp. 2015. *Stata Statistical Software* : Release 14. College Station, TX, USA: StataCorp LP.).

RESULTS

We selected 17 PTB32W patients out of the 106 infants included in the original study (16%), that had serial LU until 36 weeks' PMA and received diuretics: 8 were included in the responders group, and 9 in the non-responders group (see figure 1). We performed a total of 108 LU, with a median number of LU per patients of 6 (IQR 5-8). The assistant neonatologists started diuretic therapy at a median age of 32 days (IQR 28-39) in our sample. The responders group had a median gestational age (GA) at birth of 26 weeks (IQR 25-28), and the non-responders were born at a median GA of 27 weeks (25-29) (p=0.78). The median birth weight in the responders group was 819g (575-1060 g), and it was 760g (602-920g) in the other group (p=0.65). The rest of clinical variables in each group are shown in table 1. Both groups were different in terms of: days of invasive mechanical ventilation (median days in responders group was 27 days (IQR 11-43 days), and it was 76 days (IQR 35-117 days) in the other group, p=0.03), RS at the beginning of diuretic treatment (4 patients (50%) in the responders group were on invasive mechanical ventilation, while 8 patients (89%) in the non-responders group were intubated, p=0.048), and BPD (2 patients (25%) in the responders group developed moderate-severe BPD, while 8 patients (89%) in the non-responders group were diagnosed as moderate-severe BPD, p=0.005).

After comparing LU scores in the different moments analysed (see image 2 and table 2), we found differences after the start of diuretics between the two groups, at A2 and A4. Although there was not a statistical significant difference in the other intervals of time after diuretics, the values obtained at A5 and A6 are markedly different between the groups: at A5, median LU score was 6 (IQR 3-8) in the responders group, and 12 (IQR 7-14) in the non-responders group, p=0.08; at A6, median LU score was 5 (IQR 4-6) in the responders group, and 12 (IQR 5-13) in the non-responders group, p=0.25.

However, in terms of RS, both groups had differences from the very first day they were began on diuretics. In the following time intervals analysed, these differences remained significant (see table 3).

DISCUSSION

We found that LU scores do not change in the same way in all PTB32W after diuretics.

As we have demonstrated previously [10], BPD patients have higher LU scores than non-BPD patients, and maintain them high until 36 weeks' PMA, while non-BPD patients experience a decrease in LU scores since the very first week of life, and maintain them close to zero.

In this study, we show that there is a specific group of patients whose LU scores improve with diuretic therapy, while the other group maintain them high. Diuretics were started on day 30 to 35 in both groups, and the number of BPD patients in both groups was similar, so the expected LU score evolution in all of them would have been to remain high until 36 weeks' PMA, according to our previous study.

In the responders group, the RS was reduced since the very first interval of time studied, when we compared it to the other group. On parallel, LU score also improved in the responders group, although a few days later: probably the small sample size made that not all intervals reached statistical significance when comparing LU score after diuretics.

This can be explained because BPD is a multifactorial disease, not just influenced by an increase in lung extravascular water. LU is a very sensitive method to detect an excess of lung extravascular water[15], and that makes LU very useful to study the lung water content in neonates at birth [25], to predict the need of admission and respiratory support [4], and non-invasive ventilation failure [5,6]. But the lung with BPD also includes an inflammatory damage, with a decrease of alveolar type cells in the alveoli and of elastin fibres in the extravascular matrix, while there is an increase of collagen fibres that grow under-regulated, and a decrease in pulmonary microvasculature[26]. Although LU score correlates with the degree of lung inflammation in preterm infants with hyaline membrane disease[16], it is very usual to have infants with evolving BPD, or recovering from BPD, whose LU scores remain the same thorough their initial admission in NICU [10]. This condition can explain why LU improves later than clinical condition in preterm infants on diuretics.

Our findings should be interpreted with caution: although GA, birth weight, CRIB, CRIB-II and SNAPPE-II indexes were similar in both groups, half of the responders group were extubated at diuretics initiation, while just one patient in the non-responders group. As this is a retrospective analysis, diuretics were prescribed according to the assistant neonatologist's criteria, thus it could be that the responders group was composed by a subgroup of PTB32W with a milder form of BPD than the non-responders group: in fact, we had less moderate-severe BPD patients in the responders group (25% versus 89% in the non-responders group, p=0.005), and they received shorter courses of diuretics (12 days (IQR 4-14) versus 59 days (IQR 45-65), p=0.035).

As we described earlier [10], LU score decreases later in the most immature patients that don't develop moderate-severe BPD: patients born before 28 weeks of GA have higher values of LU score physiologically, even though they have healthy lungs, and LU score in them cannot predict BPD as early as the first week of life. It could well be that our responders' group are those more immature infants without moderate-severe BPD, that would have improved their LU scores anyway, without needing diuretics.

For all these reasons, the main limitation of our study is its retrospective and not-blinded design, because we cannot assure that the changes described in LU score in the responders group are due to diuretic treatment.

Further research on this topic is warranted, as maybe LUS score progression after treatment (diuretics, corticosteroids…) could be a suitable biomarker of DBP development in PTB32W.

CONCLUSSION

There is a group of PTB32W whose LU score improves after diuretics. This change appears later than that observed in the RS, but soon enough to be a suitable tool to monitor BPD progression in PTB32W on diuretics.

REFERENCES

1. Vergine M, Copetti R, Brusa G, Cattarossi L. Lung ultrasound accuracy in respiratory distress syndrome and transient tachypnea of the newborn. Neonatology. 2014;106(2):87–93. doi:10.1159/000358227

2. Corsini I, Parri N, Gozzini E, Coviello C, Leonardi V, Poggi C, Giacalone M, Bianconi T, Tofani L, Raimondi F, et al. Lung Ultrasound for the Differential Diagnosis of Respiratory Distress in Neonates. Neonatology. 2019;115(1):77–84. doi:10.1159/000493001

3. Raimondi F, Rodriguez Fanjul J, Aversa S, Chirico G, Yousef N, De Luca D, Corsini I, Dani C, Grappone L, Orfeo L, et al. Lung Ultrasound for Diagnosing Pneumothorax in the Critically Ill Neonate. The Journal of Pediatrics. 2016;175:74-78.e1. doi:10.1016/j.jpeds.2016.04.018

4. Raimondi F, Migliaro F, Sodano A, Umbaldo A, Romano A, Vallone G, Capasso L. Can neonatal lung ultrasound monitor fluid clearance and predict the need of respiratory support? Critical Care (London, England). 2012;16(6):R220. doi:10.1186/cc11865

5. Raimondi F, Migliaro F, Sodano A, Ferrara T, Lama S, Vallone G, Capasso L. Use of Neonatal Chest Ultrasound to Predict Noninvasive Ventilation Failure. PEDIATRICS. 2014;134(4):e1089–e1094. doi:10.1542/peds.2013-3924

6. Rodríguez-Fanjul J, Balcells C, Aldecoa-Bilbao V, Moreno J, Iriondo M. Lung Ultrasound as a Predictor of Mechanical Ventilation in Neonates Older than 32 Weeks. Neonatology. 2016;110(3):198–203. doi:10.1159/000445932

7. Brat R, Yousef N, Klifa R, Reynaud S, Shankar Aguilera S, De Luca D. Lung Ultrasonography Score to Evaluate Oxygenation and Surfactant Need in Neonates Treated With Continuous Positive Airway Pressure. JAMA Pediatrics. 2015;169(8):e151797. doi:10.1001/jamapediatrics.2015.1797

8. De Martino L, Yousef N, Ben-Ammar R, Raimondi F, Shankar-Aguilera S, De Luca D. Lung Ultrasound Score Predicts Surfactant Need in Extremely Preterm Neonates. Pediatrics. 2018;142(3):e20180463. doi:10.1542/peds.2018-0463

9. Abdelmawla M, Louis D, Narvey M, Elsayed Y. A Lung Ultrasound Severity Score Predicts Chronic Lung Disease in Preterm Infants. American Journal of Perinatology. 2019;36(13):1357–61. doi:10.1055/s-0038-1676975

10. Alonso-Ojembarrena A, Lubián-López SP. Lung ultrasound score as early predictor of bronchopulmonary dysplasia in very low birth weight infants. Pediatric Pulmonology. 2019;54(9):1404–1409. doi:10.1002/ppul.24410

11. Gullett J, Donnelly JP, Sinert R, Hosek B, Fuller D, Hill H, Feldman I, Galetto G, Auster M, Hoffmann B. Interobserver agreement in the evaluation of B-lines using bedside ultrasound. Journal of Critical Care. 2015;30(6):1395–1399. doi:10.1016/j.jcrc.2015.08.021

12. Santos TM, Franci D, Coutinho CMG, Ribeiro DL, Schweller M, Matos-Souza JR, Carvalho-Filho MA. A simplified ultrasound-based edema score to assess lung injury and clinical severity in septic patients. The American Journal of Emergency Medicine. 2013;31(12):1656–1660. doi:10.1016/j.ajem.2013.08.053

13. Girona-Alarcón M, Cuaresma-González A, Rodríguez-Fanjul J, Bobillo-Perez S, Inarejos E, Sánchez-de-Toledo J, Jordan I, Balaguer M. LUCAS (lung ultrasonography in cardiac surgery) score to monitor pulmonary edema after congenital cardiac surgery in children. The Journal of Maternal-Fetal & Neonatal Medicine. 2020 Mar 26:1–6. doi:10.1080/14767058.2020.1743660

14. Singh Y, Tissot C, Fraga MV, Yousef N, Cortes RG, Lopez J, Sanchez-de-Toledo J, Brierley J, Colunga JM, Raffaj D, et al. International evidence-based guidelines on Point of Care Ultrasound (POCUS) for critically ill neonates and children issued by the POCUS Working Group of the European Society of Paediatric and Neonatal Intensive Care (ESPNIC). Critical Care. 2020;24(1):65. doi:10.1186/s13054-020-2787-9

15. Zong H, Guo G, Liu J, Bao L, Yang C. Using lung ultrasound to quantitatively evaluate pulmonary water content. Pediatric Pulmonology. 2020;55(3):729–739. doi:10.1002/ppul.24635

16. Yousef N, Vigo G, Shankar-Aguilera S, De Luca D. Semiquantitative Ultrasound Assessment of Lung Aeration Correlates With Lung Tissue Inflammation. Ultrasound in Medicine & Biology. 2020;46(5):1258–1262. doi:10.1016/j.ultrasmedbio.2020.01.018

17. Mandell EW, Kratimenos P, Abman SH, Steinhorn RH. Drugs for the Prevention and Treatment of Bronchopulmonary Dysplasia. Clinics in Perinatology. 2019;46(2):291–310. doi:10.1016/j.clp.2019.02.011

18. Kao LC, Warburton D, Sargent CW, Platzker ACG, Keens TG. Furosemide acutely decreases airways resistance in chronic bronchopulmonary dysplasia. The Journal of Pediatrics. 1983;103(4):624–629. doi:10.1016/S0022-3476(83)80602-7

19. Stewart A, Brion LP. Intravenous or enteral loop diuretics for preterm infants with (or developing) chronic lung disease Cochrane Neonatal Group, editor. Cochrane Database of Systematic Reviews. 2011 Sep 7 [accessed 2020 Apr 17]. http://doi.wiley.com/10.1002/14651858.CD001453.pub2. doi:10.1002/14651858.CD001453.pub2

20. Stewart A, Brion LP, Ambrosio-Perez I. Diuretics acting on the distal renal tubule for preterm infants with (or developing) chronic lung disease Cochrane Neonatal Group, editor. Cochrane Database of Systematic Reviews. 2011 Sep 7 [accessed 2020 Apr 17]. http://doi.wiley.com/10.1002/14651858.CD001817.pub2. doi:10.1002/14651858.CD001817.pub2

21. Kao LC, Durand DJ, McCrea RC, Birch M, Powers RJ, Nickerson BG. Randomized trial of long-term diuretic therapy for infants with oxygen-dependent bronchopulmonary dysplasia. The Journal of Pediatrics. 1994;124(5):772–781. doi:10.1016/S0022-3476(05)81373-3

22. Blaisdell CJ, Troendle J, Zajicek A, Chougnet C, Greenberg JM, Hardie W, Jobe AH, McDowell K, Ferkol T, Holland MR, et al. Acute Responses to Diuretic Therapy in Extremely Low Gestational Age Newborns: Results from the Prematurity and Respiratory Outcomes Program Cohort Study. The Journal of Pediatrics. 2018;197:42-47.e1. doi:10.1016/j.jpeds.2018.01.066

23. Greenberg RG, Gayam S, Savage D, Tong A, Gorham D, Sholomon A, Clark RH, Benjamin DK, Laughon M, Smith PB. Furosemide Exposure and Prevention of Bronchopulmonary Dysplasia in Premature Infants. The Journal of Pediatrics. 2019;208:134-140.e2. doi:10.1016/j.jpeds.2018.11.043

24. Walsh MC, Yao Q, Gettner P, Hale E, Collins M, Hensman A, Everette R, Peters N, Miller N, Muran G, et al. Impact of a physiologic definition on bronchopulmonary dysplasia rates. Pediatrics. 2004;114(5):1305–1311. doi:10.1542/peds.2004-0204

25. Blank DA, Rogerson SR, Kamlin COF, Fox LM, Lorenz L, Kane SC, Polglase GR, Hooper SB, Davis PG. Lung ultrasound during the initiation of breathing in healthy term and late preterm infants immediately after birth, a prospective, observational study. Resuscitation. 2017;114:59–65. doi:10.1016/j.resuscitation.2017.02.017

26. Surate Solaligue DE, Rodríguez-Castillo JA, Ahlbrecht K, Morty RE. Recent advances in our understanding of the mechanisms of late lung development and bronchopulmonary dysplasia. American Journal of Physiology-Lung Cellular and Molecular Physiology. 2017;313(6):L1101–L1153. doi:10.1152/ajplung.00343.2017

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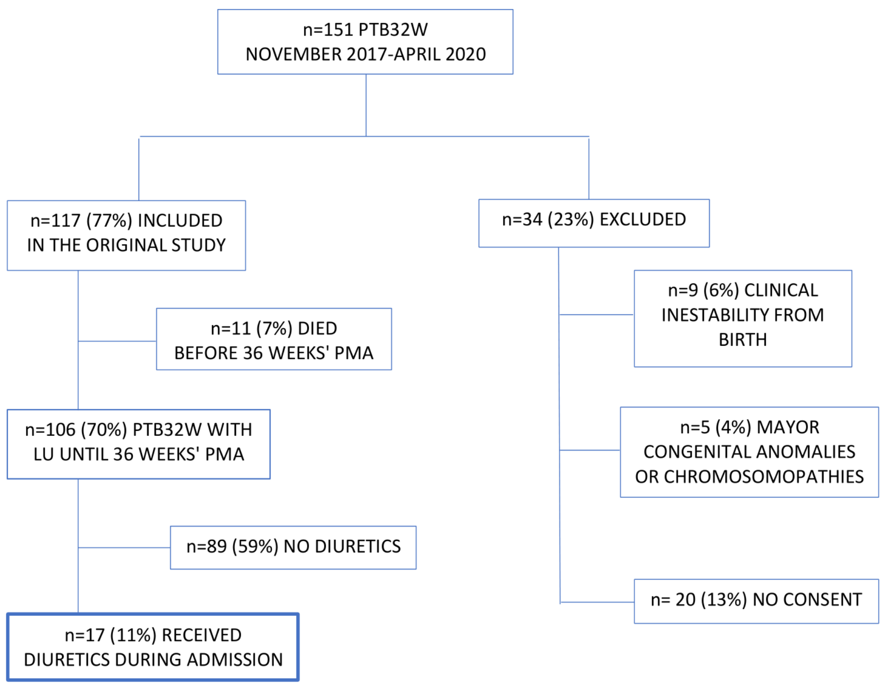

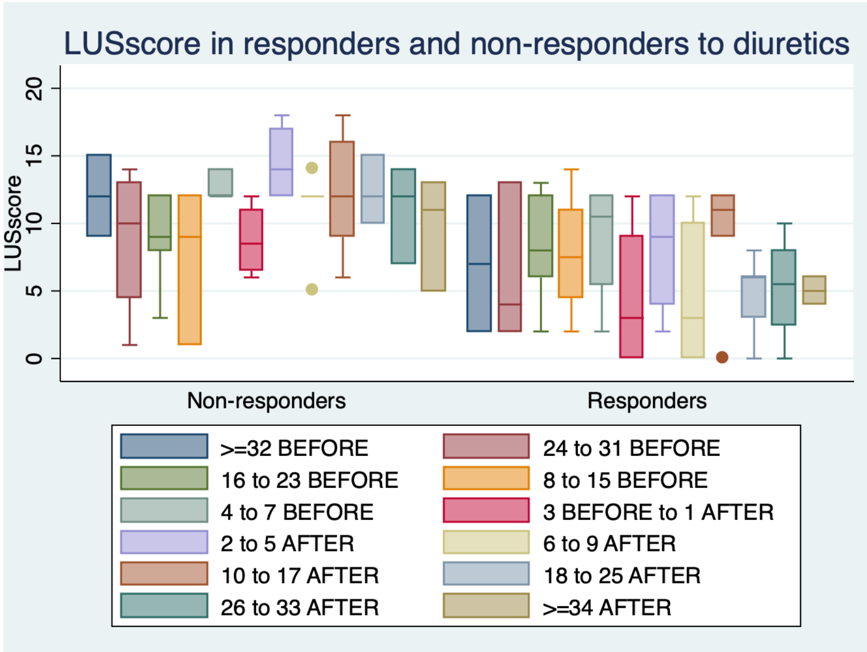
LUSscore in responders and non-responders to diuretics
LUSscore
0
5
10
15
20
Non-responders
Responders
>=32 BEFORE
24 to 31 BEFORE
16 to 23 BEFORE
8 to 15 BEFORE
4 to 7 BEFORE
3 BEFORE to 1 AFTER
2 to 5 AFTER
6 to 9 AFTER
10 to 17 AFTER
18 to 25 AFTER
26 to 33 AFTER
>=34 AFTER