



Determination of a mathematical score of survival in newborn foals: Retrospective study on foals admitted to intensive care at the Clinéquine Between 2007 and 2020



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INTRODUCTION

During the neonatal period, foals are very susceptible to disease. Their state of health can deteriorate suddenly, and appropriate medical care requires time-consuming and expensive intensive care. Neonatology is extremely time-consuming emergency medicine. Therefore, it is governed by the will and the economic possibility of the owners to hire intensive care. Thus, predictive survival tools are very useful when it comes to making decisions. This warrants an accurate assessment of the vital prognosis on admission based on clinical exam and ancillary tests, for ethical reasons as well as economical considerations.

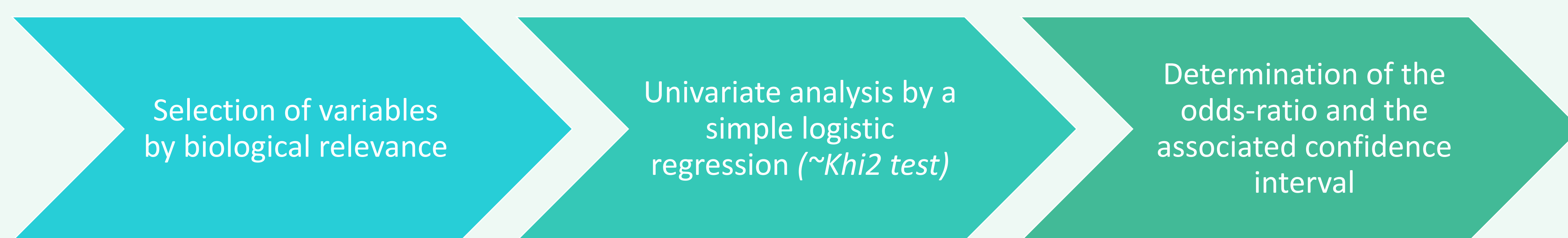
OBJECTIVES

- To determine prognostic factors of survival or non-survival of newborn foals, from the data of the anamnesis, the clinical examination and the first complementary examinations carried out during the admission, regardless of the pathologies presented
- Determination of a mathematical score of survival in newborn foals

MATERIALS AND METHODS

Examination of the medical records of 226 foals less than 21 days old, of all breeds and both sex, hospitalized at intensive care between 2007 and 2020 and for which the outcome "survival" or "non-survival" was known.

Determination of prognostic factors of survival



Creation of the survival score



| Variables | Categories | Foals | Mortality | Odd-ratio | 95% Confidence interval | P-value |
|---------------------------|---------------------------------|-------|-----------|------------|-------------------------|----------------------------|
| Ability to stand | YES | 133 | 20,3 % | Reference | | |
| | NO | 65 | 63,1 % | 6,7 | 3,4 – 13,1 | 1,4x10⁻⁸ |
| Suckling reflex | Present | 84 | 21,4 % | Reference | | |
| | Absent | 49 | 53,1 % | 4,1 | 1,9 – 9,1 | 0,0003 |
| Color of mucous membranes | Pink | 110 | 22,7 % | Reference | | |
| | Modified | 99 | 44,4 % | 2,7 | 1,5 – 5,0 | 0,001 |
| Quality of arterial pulse | Normal | 205 | 29,2 % | Reference | | |
| | Weak | 21 | 57,1 % | 3,2 | 1,3 – 8,2 | 0,01 |
| Heart rate | Normal | 107 | 28 % | Reference | | |
| | Bradycardia | 8 | 75 % | 7,7 | 1,4 – 41,7 | 0,02 |
| Cold extremities | Tachycardia | 89 | 37,1 % | 1,5 | 0,82 – 2,8 | 0,2 |
| | NO | 203 | 29% | Reference | | |
| Rectal temperature | YES | 20 | 65 % | 4,5 | 1,7 – 12,2 | 0,002 |
| | Normal | 108 | 27,8 % | Reference | | |
| Blood pH | Hypothermia | 23 | 73,9 % | 7,4 | 2,6 – 20,9 | 0,0001 |
| | Hyperthermia | 60 | 30 % | 1,1 | 0,55 – 2,3 | 0,76 |
| Anion gap | < 7,39 | 34 | 58,8 % | 1,8 | 0,68 – 4,7 | 0,2 |
| | 7,39 – 7,45 | 36 | 44,4 % | Reference | | |
| Hematocrit | > 7,45 | 36 | 19,4 % | 0,3 | 1,1 – 9,7 | 0,02 |
| | < 9 | 1 | 100 % | NS | | |
| Neutrophils | 9 – 25 | 70 | 30 % | Reference | | |
| | > 25 | 7 | 85,7 % | 14 | 1,5 - 129 | 0,02 |
| Fibrinogen | < usual range | 33 | 45,4 % | 2,2 | 1,0 – 4,8 | 0,05 |
| | Usual range | 130 | 27,7 % | Reference | | |
| Creatinine kinase | > usual range | 33 | 54,5 % | 3,1 | 1,4 – 7,0 | 0,004 |
| | < 4,5 x 10 ³ /µL | 64 | 48,4 % | 3,8 | 1,7 – 8,5 | 0,0007 |
| Glucose | 4,5 – 8,5 x 10 ³ /µL | 66 | 19,7 % | Reference | | |
| | > 8,5 x 10 ³ /µL | 59 | 35,6 % | 2,3 | 0,99 – 5,1 | 0,048 |
| Blood lactates | < 4 g/L | 99 | 31,3 % | Reference | | |
| | > 4 g/L | 31 | 48,4 % | 2,1 | 0,89 – 4,8 | 0,08 |
| Glucose | Normal | 68 | 25 % | Reference | | |
| | Hyperlactatemia | 48 | 58,3 % | 4,2 | 1,9 – 9,4 | 0,0004 |
| Creatinine kinase | Usual range | 55 | 29,1 % | Reference | | |
| | > usual range | 38 | 47,4 % | 2,2 | 0,91 – 5,3 | 0,07 |
| Glucose | <6,7 mmol/L | 60 | 53,3 % | 3,0 | 1,4 – 6,4 | 0,005 |
| | 6,7 – 10 mmol | 61 | 27,9 % | Reference | | |
| Glucose | > 10 mmol/L | 22 | 31,8 % | 1,2 | 0,41 – 3,5 | 0,73 |

Table 1 : Results of univariate analysis for clinical and biological risk factors

RESULTS

15 mortality risk factors used as prognostic tools have been identified as statistically significant. They are summarized in table 1.

Factors in the final model included inability of the foal to stand, hematocrit, and neutrophils count. The correspondence between the score and the associated survival probability is presented in the table 2

$$\text{Score} = 2,45 - 1,1 \times \text{HtDIMINUE} - 1,2 \times \text{HtAUGMENTE} - 0,8 \times \text{NEUTROPENIE} - 1,5 \times \text{NEUTROPHILIE} - 2 \times \text{Station_deboutNON}$$

Sensitivity = 83,7% ; Specificity = 63,6%

Positive predictive values = 79,4% ; Negative predictive values = 70%

| Score | Probability of survival |
|-------|-------------------------|
| -2,25 | 0,09 |
| -2,15 | 0,10 |
| -1,55 | 0,17 |
| -1,45 | 0,19 |
| -1,05 | 0,26 |
| -0,75 | 0,32 |
| -0,65 | 0,34 |
| -0,35 | 0,41 |
| -0,25 | 0,44 |
| -0,15 | 0,46 |
| 0 | 0,5 |
| 0,45 | 0,61 |
| 0,55 | 0,63 |
| 0,95 | 0,72 |
| 1,25 | 0,78 |
| 1,35 | 0,79 |
| 1,65 | 0,83 |
| 2,45 | 0,92 |

Table 2 : Score and associated survival

CONCLUSIONS

This study provides strong correlations between mortality and a reasonable number of usual clinical and clinical pathology parameters, directly usable in the neonatal period. Based on our foal population presenting a wide array of affections and breeds, we show that a core list of parameters involved in usual neonate assessment allows us to provide useful prognostic values and the survival score established in our study can be easily implemented using data available at the admission. Further evaluations of this scoring system in a prospective study are needed.