

PROJECT SUMMARY



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Short term and future athletic performance of critically ill equine neonate

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Overview

This project investigated the short and long term survival of critically ill neonatal foals. The primary objective of this study was to provide the race horse breeder and veterinarian with information to assist them in making the decision to pursue the treatment of their critically-ill neonate.

The results of this research will provide veterinarians and thoroughbred horse breeders with objective information to identify clinical parameters of the critically-ill neonatal foal which will have a negative impact on their short-term survival and future athletic performance.



Background

Equine neonatal care has improved dramatically over the last 30 years, resulting in an improvement in the veterinarian's ability to successfully treat the critically ill equine neonate. It is however not known whether this improvement in the treatment and survival of the neonate has resulted in a horse which will reach its full potential as yearling or an athlete. The critically-ill neonate who does not reach its full potential is a significant cause of wastage in the thoroughbred breeding industry through costs of treating the foal, management and personnel costs in raising a foal to a racehorse.

Survival rates for critically ill neonates have improved from 26% in the 1980's¹ to over 80% reported in recent studies.^{2,3,4,5} Recent studies have also investigated admission parameters in an attempt to predict factors on admission that are related to a poor or successful short-term prognosis in the critically-ill foal. Numerous parameters have been identified, however many of the significant factors vary between studies, foal populations and geographic location.^{2,3,4,5,6,7,8,9,10,11,12,13}

There have been few studies on the long term survival and athletic performance of the critically-ill foal. In one report on bacteraemic thoroughbred foals, there was no significant difference in the percentage of starters, percentage of winners or number of race starts, however the Neonatal Intensive Care Unit (NICU) survivors had a lower number of wins, total earnings and Standard Start Index compared with the control maternal siblings.⁴ This is similar to another report where the percentage of starters was lower, however there was no difference in the NICU survivors to the control population's performance over a two year period.³ In a study on sales performance of NICU thoroughbred survivor, there was no difference when compared with the control population.¹⁴

This retrospective study aims to investigate the short-term and future athletic performances of critically ill foals admitted to an intensive care unit in Australia and identify parameters that can be used to help identify the foals that are at risk of not surviving or not reaching their full athletic potential.



Methods used

The project was a retrospective study of critically-ill equine neonates.

The records of thoroughbred foals less than 7 days of age admitted to the Scone Veterinary Hospital's Clovelly Intensive Care Unit from 1999 to 2006 were reviewed. Data collected from the records was collated and evaluated.

Historical, admission and treatment parameters for the foals were analysed.

Short-term survival was based on live discharge from hospital. A good short term outcome was defined as a foal that survived to be discharged from hospital. Long-term survival and future performance of the NICU survivor was based upon sale at a yearling sales, registration with the Australian Studbook, and race records. The NICU survivor's performance was compared to the survivor's maternal siblings. The foals that had no maternal siblings were excluded from the long-term survival analysis.

Univariate screening analyses were used to identify those characteristics of the mare and foal that were associated with foal survival, sale at a weanling or yearling sale, or achieved one race. A cut-off level for all continuous variables that were associated foal survival (Table 1), sale at a weanling or yearling sale (Table 2), or achieved one race (Table 3) was determined using receiver operator characteristic curve analysis. Variables that were associated with the outcomes in univariate screening were then used in multivariable logistic regression modelling. Final multivariable models were developed using backward stepwise progression and only significant variables were retained in the final models.

Results and Discussion

Objective 1

Admission parameters and clinical problems that affect survival

Of the 628 critically ill foals included in this study, 544 (86.6%) were discharged from the NICU. From these surviving foals 306 (56 %) were sold as weanlings or yearlings and 403 (74%) had one race.

Foals that were delivered from mares that had placentitis, premature placental separation or required a caesarean were less likely to have a good short-term outcome. Foals that had good short term outcome were from mares with lower parity, had a longer gestational length and were older at admission. Foals that were standing or nursing at admission were more likely to be discharged from the NICU.

Foals that were recumbent, weighed less than 40 kg, had seizures or were premature/dysmature at admission were less likely to have a good short term outcome. Foals that had failure of passive transfer of immunity, Systemic Inflammatory Response Syndrome (SIRS) or sepsis score > 11, or neonatal syndrome were less likely to have a good short term outcome. Seizures during hospitalisation, increased number of days recumbent, the requirement for pressor support, total parenteral nutrition, anticonvulsant treatment or any complications during hospitalisation reduced the chance of a good short term outcome.

Foals that were discharged from the NICU had a higher heart rate, respiratory rate and temperature at admission than foals with a poor short term outcome. The admission blood white cell count and neutrophil count of foals that survived were higher than in the foals that were euthanased in the NICU.

Variable	Cut-off Level
Parity (years)	3
Gestational Length (Days)	331
Age of Admission (Days)	0.75
Days Recumbent	0.01
Heart Rate (beats/min)	90
Respiratory Rate (Breaths/min)	58
Temperature (°C)	37.4
White Cell Count (x 10 ⁹ /L)	4.2
Neutrophil Count (x 10 ⁹ /L)	2.38
Glucose (umol/L)	2.92
Globulin (g/L)	18
Bicarbonate (mmol/L)	25
Lactate	4.7
Creatinine (umol/L)	195
Phosphorous (mmol/L)	2.14
Potassium (mmol/L)	4.1
Length of Hospitalisation (Days)	4

Table 1. Cut-off levels for continuous variables associated with foal survival. Variables in bold remained in the Multivariable Model.





Serum glucose, globulin and bicarbonate were higher in foals with a good short term outcome compared with foals with a poor short term outcome. Foals that were discharged from the NICU had a lower serum lactate, creatinine, phosphorous and potassium concentration at admission than foals that died. The length of hospitalisation of foals that were discharged from the NICU was longer than foals that died. Foals with a primary diagnosis of meconium impaction or diarrhoea were more likely to be discharged from hospital than foals with other diagnosis.

A multivariable model showed that foals were less like to be discharged from the NICU if they were not standing at admission and had higher serum potassium concentration. The foals that were more likely to be discharged from the NICU were those that had an increased length of stay, no complications during hospitalisation, no pressor support and no anticonvulsant therapy.

This means that foals that were standing at admission, did not require pressor support or anticonvulsant treatment, did not develop complications during hospitalisation, had lower serum potassium concentration at admission and stayed longer in the NICU were more likely to have a good short term outcome.

Objective 2

To determine which variables were associated with surviving foals reaching their sale potential.

Foals that survived were assessed to determine which variables were significantly associated with sale at a weanling or yearling sale.

Foals that were standing at admission to hospital, nursing and had higher blood glucose concentration were more likely to go to a sale. Foals delivered from mares with placentitis, were seizing at admission, were premature or dysmature, were recumbent longer, had a lower heart rate lower temperature, higher lactate higher albumin, higher serum potassium or required pressor support during hospitalisation were less likely to go to a weanling or yearling sale.

A multivariable model was developed using these variables. The model accounted for only a very small percentage of the variability in NICU foals going to a sale. However foals were less likely to go to a sale if they were seizing at admission, had lower albumin concentration and were classified as premature or dysmature.

Variable	Cut-off Level
Days Recumbent	0.33
Heart Rate (beats/min)	95
Glucose (umol/L)	3.4
Lactate	3.0
Potassium (mmol/L)	4.0
Albumin (g/L)	28

Table 2. Cut off levels for continuous variables associated with sale as a weanling or yearling. Variables in bold remained in the multivariable model

Objective 3

To determine whether surviving foals are able to have one race

There was no difference in the proportion of foals from the NICU that raced (55%) compared with their maternal siblings (46%), however foals that were treated in the NICU won fewer races, had lower performance ratings and earned less money than their maternal siblings.

Objective 4

To determine the clinical parameters of the critically ill neonatal foal which affect future athletic performance.

Foals that were discharged from the ICU were more likely to have one race if they had a longer gestational age, did not have a dystocia, were older at admission, were standing at admission, were nursing at admission, had less time recumbent in hospital, had a higher temperature at admission, did not have seizures, were more likely to have diarrhoea, meconium impaction or colic recorded as the primary diagnosis, have IgG >8 mg/dL, higher glucose, lower lactate, higher white cell count, higher neutrophil count, lower creatinine, higher globulin, lower potassium, did not require pressor support or anticonvulsant treatment and did not develop complications during hospitalisation. These results all involved comparison to the population of foals that did not race following discharge from the ICU.

The multivariable model developed using these variables showed that surviving critically ill foals were more likely to race if they were standing at admission, weighed more 40 kg and did not require pressor support during hospitalisation.

Implications and Conclusions

This project applied advanced statistical modelling to data collected from ICU admissions in a large equine veterinary hospital servicing a major thoroughbred breeding area in Australia. The findings are likely to be relevant for all breeders and veterinarians attempting to breed and raise young horses for a future racing career.

Univariate screening was used to identify those factors that might be associated with each outcome. Multivariable modelling was then used to produce final explanatory models. The benefit of multivariable modelling is that the effect of any one factor in the model is adjusted for the effects of all other factors in the model. In most situations multivariable modelling will identify a smaller list of factors that may be associated with the outcomes of interest and the results will be less biased when compared to findings from univariate screening.

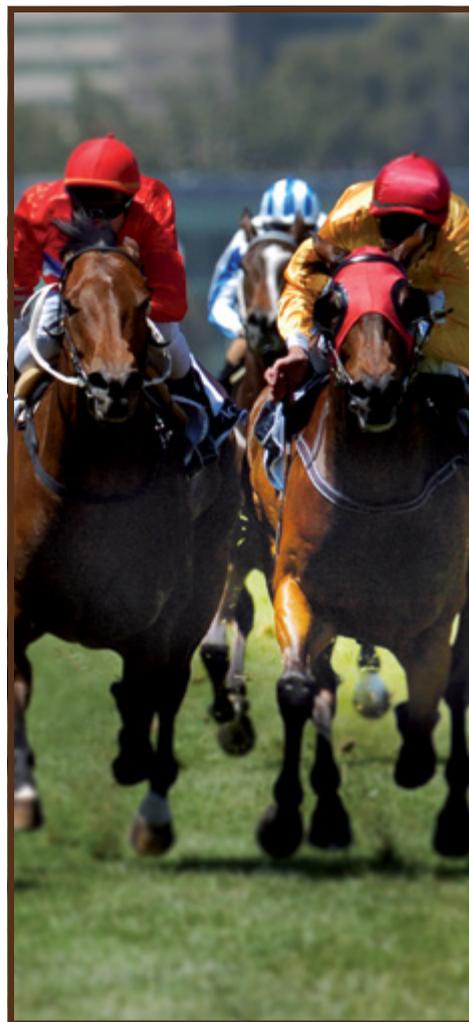
These characteristics may be considered when making a decision whether or not to proceed with intensive care for a critically ill foal.

The vast majority of foals that require intensive care soon after birth do survive and the proportion that go on to race is similar to that observed in apparently healthy siblings that do not require intensive care.

(continues overleaf)

Variable	Cut-off Level
Gestational Length (Days)	326
Age of Admission (Days)	0.6
Days Recumbent	0.08
Temperature (°C)	38
White Cell Count (x 10 ⁹ /L)	5.2
Neutrophil Count (x 10 ⁹ /L)	3.65
Glucose (umol/L)	3.96
Globulin (g/L)	28
Lactate	3.4
Creatinine (umol/L)	125
Potassium (mmol/L)	4.1

Table 3. Cut off levels for continuous variables associated with a surviving foal competing in one race. No variable remained in the multivariable model.





However the surviving critically ill foals do not win as many races, earn as much money or have as high a race rating when compared to apparently healthy siblings. Critically ill foals were less likely to survive ICU if they were unable to stand at admission and had a higher serum potassium concentration, required pressor support and anticonvulsant therapy, developed complications during hospitalisation and had a shorter stay in the NICU.

Foals that were critically ill and survived intensive care, were less likely to be sold as a weanling or yearling if they were seizing at admission, had a lower serum albumin concentration and were classified as premature or dysmature. Foals that subsequently went on to race were standing at admission, did not require pressor support and weighed more than 40 kg.

The ability to stand and whether a critically ill foal requires pressor support are important factors in both short term and long term outcomes. However the size of the foal or whether it is premature or dysmature is only important in regard to long term outcomes. Understanding these variables will help veterinarians, farms managers and owners decide appropriate treatment options for critically ill foals.



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