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Comparison of Immune Status Using Diagnosis of Failure of Passive Transfer in Healthy and Sick Horse Population : A Pilot Study

건강한 말과 아픈 말에서 수동면역부전 진단을 이용한 면역상태 비교 : 파일럿 스터디

J. Yang *
양재혁
한국농수산대학
말산업학과 1
equinfluenza@daum.net

Abstract

The current study is the first paper on FPT(failure of passive transfer) of horse population in Korea. The object of this study was to comparison of immune status normal and patient horses. Failure of passive transfer is the most common immunodeficiency disorder of horses. Twenty-two foals and 18 horses from Jeju of the equine hospital were diagnosed with the SNAP Foal IgG Test Kit. All adult horses had normal immune functions (≥ 800 mg/dl). Thirteen of the 22 newborn babies (59%; ∠800 mg/dl) had a weak immune function but recovered and survived after treatment. Nine of these 22 are horses with strong immunity (≥800 mg/dl), indicating that high IgG concentrations in the blood can cause infectious diseases. There were a total of six dead, four of which were infectious diseases. In addition, early identification of infectious diseases in newborn foals is expected to help prepare systematic health management measures for the development of the disease.

Key Words : Dead foals, Failure of Passive Transfer, Immune status, Thoroughbred horse

*교신저자
1 Department of Horse Industry, Korea National College of Agriculture and Fisheries

Ⅰ. Introduction

There was rare study on immunology of foals. Failure of transfer of passive immunity (FPT) is the most common immunodeficiency disorder of young horses. Sepsis has been implicated as the major cause of morbidity and mortality in the equine neonate. Most postnatal risk factors are very much intertwined with possible routes of infection. The main exception to this is FPT (Sanchez, 2014).

Unsanitary environmental conditions can result in an increased bacterial load to the neonatal gastrointestinal tract, especially during the initial periods of udder seeking. Septic foals may have additional localizing signs associated with specific foci if infection. Diarrhea is common and may be the first clinical sign observed (Sanchez, 2014).

FPT occurs when a foal fails to ingest a sufficient quantity of high-quality colostrum. FPT may result from the following: failure of the foal to suck from the dam for any reason and failure of the dam to produce sufficient quantity of high-quality colostrum (Sell and Wilkins, 2010).

Foals with sepsis commonly have a serum IgG concentration of less than 800 mg/dL (Brewer *et al*. 1988). Foals with FPT are more likely to die from sepsis (Raidal 1996, Tyler-McGowan 1997). Foals not presently ill and on well-managed farms with low population density and low prevalence of disease may not require treatment if their IgG concentration is between 400 and 800 mg/dL (Wilkins and Dewan-Mix 1994). Foals with FPT may be treated by oral or intravenous administration of various products containing IgG (Klobasa *et al*. 1998).

There has been no report on FPT of horse population in South Korea. Therefore, the purpose of this study was to determine the value of IgG in blood in healthy and sick horses because early identification of infectious diseases in newborn foals is expected to help prepare systematic health management measures for the development of the disease.

Ⅱ. Materials and Methods

1. Animals:

Sick twenty-two sucklings and normal 18 foals and horses from the equine hospital were tested.

2. Methods:

After collecting blood from the jugular vein of the visiting horse, the blood was refrigerated and moved to the laboratory.

The diagnosis of the failure of passive transfer were carried out the manuals by the manufacturing company(the SNAP Foal IgG Test Kit®).

3. Interpreting the test result:

To determine the level of IgG in the test sample, compare the color of the sample spot to the color of the two calibrator spots.

① Less than 400 mg/dL IgG: The color intensity of the sample spot is lighter than the 400 mg/dL calibrator spot.

② Approximately 400 mg/dL IgG: The color intensity of the sample spot is the same as the 400 mg/dL calibrator spot.

③ 400 to 800 mg/dL IgG: The color intensity of the sample spot is darker than the 400 mg/dL calibrator spot but lighter than the 800 mg/dL calibrator spot.

④ Approximately 800 mg/dL IgG: The color intensity of the sample spot is the same as the 800 mg/dL calibrator spot.

⑤ Greater than 800 mg/dL IgG: The color intensity of the sample spot is darker than the 800 mg/dL calibrator spot.

Ⅲ. Results

All adult horses had normal immune functions (≥800 mg/dl) (Table 1).

Thirteen of the 22 foals (59%; ∠800 mg/dl) were vulnerable to immune function and appear to be linked to the outbreak of infectious diseases in the end. Nine of these 22 are horses with strong immune function (≥ 800 mg/dl), indicating that high IgG concentrations in the blood can cause infectious diseases (Table 2).

There were a total of six dead, four of which were infectious diseases (Table 3).

Table 1. Numbers of normal and sick horses by age

Type	<800 mg/dL	≥800 mg/dL	Total
Sucklings	13	9	22
Yearlings	1	5	6
Adults	-	12	12
Total	14	26	40

Table 2. Numbers of sick horse population by diseases

Type	<800 mg/dL	≥800 mg/dL	Total
Pneumonia	7	3	10
Diarrhea	1	2	3
Infectious arthritis	0	1	1
Others	5	3	8
Total	13	9	22

Table 3. Immune status of dead foals

Type	<800 mg/dL	≥800 mg/dL	Total
Fillies	1	-	1
Colts	2	3	5
Total	3	3	6

IV. Discussion

Foals should receive colostrum within 7 hours of birth to optimize absorption and health in the neonatal period. A common recommendation is to achieve a minimum serum IgG concentration of 800 mg/dL In foals 18-24 hours of age and older, FPT is defined as serum IgG concentrations < 200 mg/dL (2 g/L) and PFPT as IgG concentrations between 200 and 800 mg/dL (4-8g/L) (Hines, 1997). The incidence of FPT in different parts of the world is 10-18% (Nath *et al*., 2010). Foals experiencing FPT or PFPT have a 50% incidence of infectious disease in the first weeks of life (McGuire, 1997). The Predominant immunoglobulin in equine colostrum is IgG (1500-5000 mg/dL) with lesser quantities of IgA (500-1500 mg/dL), IgM (100-350 mg/dL), and IgG(T) (500-2500 mg/dL) (Tizard, 1987). Passive antibody concentrations in foals decline rapidly during the first 4 weeks of life, largely because of catabolism of antibody and dilution in the increasing plasma volume of the growing foal (Jeffcott, 1975). Foals that are completely colostrum deprived (IgG < 200 mg/dL) are at extremely high risk for sepsis even when management practices are optimal (Robinson *et al*., 1993). The majority of foals presenting for treatment of sepsis have concurrent FPT (Koterba *et al*., 1984), however, partial FPT (IgG concentration of 200-800 mg/dL) is not always associated with increased prevalence of illness or death (Baldwin *et al*., 1991; Clabough *et al*., 1991). Serum IgG levels are used as an indicator of protection against disease, but the specificity of the immunoglobulin against individual pathogens in the foal's environment or efficacy of protection in the gut lumen cannot be evaluated. IgG in the foal's blood is used as an indicator only of the ability of the foal to resist disease in the neonatal period (Vivrette, 2011).

Immuno deficiencies are disorders resulting from the absence or failure of function of one or more components of the immune system. The commonest secondary immunodeficiency of horses is failure of passive transfer of immunoglobulin in neonatal foals. Foals with failure of passive transfer are at increased risk for septicemia or other bacterial infections. Adult horses with acquired immunodeficiencies often present with clinical signs of recurrent or persistent infections, poor response to appropriate antimicrobial therapy, or infection with normally nonpathogenic organisms (Sellon, 2000).

Passive immunity, acquired from the dam, is essential for protection during the first month of life. In the interim between birth and production of adequate spectrum and quantity of specific immunoglobulin by the foal, passive immunity is dependent on ingestion of colostrum. Failure of the foal to ingest or absorb sufficient immunoglobulin from colostrum is referred to as FPT of immunoglobulin. FPT is the most important risk factor for localized or systemic bacterial infection in foals during the first month of life and is the commonest immunologic disorder of foals (Koterba *et al*., 1984, McGuire *et al*., 1977).

Such infections may result in septicemia, diarrhea, and joint and/or umbilical infections (Vivrette, 2011). Many maternal and postnatal events can predispose an equine neonate to infection, including maternal illness, alterations in gestational length, partial or complete failure of passive transfer of immunity, poor sanitary conditions, and improper umbilical care. These problems were contributing factors in 24% of bacteremic foals in a recent study (Sanchez, 2014).

Because the foal is relatively immune naive at the time of birth, postnatal transfer of immunoglobulin through ingestion and absorption of colostral antibodies is critical for prevention of foal infection. A number of studies have documented a close relationship between the concentration of foal serum immunoglobulin G (IgG) and incidence of disease (Sanchez, 2014).

Clearly, factors other than the magnitude of passive transfer also are involved in determining disease risk. Farm management is particularly important, including general cleanliness, stocking density, exposure to disease, maternal nutrition, and prepartum vaccination and deworming programs. One study has demonstrated that foals with partial FPT were at no greater risk of disease than those with adequate transfer on a well-managed Standardbred farm (Sanchez, 2014).

Postnatal routes of infection include the umbilicus, gastrointestinal (GI) tract, and respiratory tract. Significant postnatal factors other than FPT that affect risk for neonatal sepsis include gestational age and environmental conditions. Foals with exceptionally short or long gestation are at increased risk for the development of sepsis (Sanchez, 2014).

Several methods are available for measuring IgG concentration in blood; the most reliable are enzyme-linked immunosorbent assay and single radial immunodiffusion technology-based tests. The

concentration of IgG in the blood of the foal has been used as an indicator of the adequacy of passive transfer, but the actual blood concentration at which FPT is diagnosed has been challenged in recent years (Sell and Wilkins 2010).

Traditionally, FPT to the foal has been considered to be the most important factor in disease prevention. Other factors clearly play a role, however, adequate immunoglobulin transfer should still be assessed and treated, if necessary. (Sanchez 2014)

It had no significant effect on the development of immune status in dead foals. The results of the current study support the value of routine monitoring of passive immune status and the early speculative treatment of foals considered to be at risk for the development of FPT.

The government aims to improve the utilization rate of horse industrial resources such as racehorse and improve the health management technology by providing early diagnosis and countermeasures to the degree of infection vulnerability through the examination of the immune status of newborn foals.

V. References

1. Baldwin, J. L., W. L. Cooper, D. K. Vanderwall, H. N. Erb. (1991). Prevalence (treatment days) and severity of illness in hypogammaglobulinemic and normogammaglobulinemic foals. J Am Vet Med Assoc. 198: 423-428.
2. Clabough, D. L., J. F. Levine, G. L. Grant, H. S. Conboy. (1991). Factors associated with failure of passive transfer of colostral antibodies in Standardbred foals. J Vet Intern Med. 5: 335-340.
3. Jeffcott, L B. (1975). The transfer of passive immunity to the foal and its relation to immune status after birth. J Reprod Fertil Suppl. 23: 727-733.
4. Hines, M. T. (1997). Immunnodeficiencies of foals. In: Current Therapy in Equine Medicine, 4th ed. Philadelphia: Saunders. 581-582.
5. Klobasa, F., M. C. Goel, E. Werhahn. (1998). Comparison of freezing and lyophilizing for preservation of colostrum as a source of immunoglobulins for calves. J Anim Sci. 76: 923-926.
6. Koterba, A. M., B. D. Brewer, F. A. Tarplee. (1984). Clinical and clinicopathological characteristics of the septicaemic neonatal foal: review of 38 cases. Equine Vet J. 16: 376-382.
7. McGuire, T. C., T. B. Crawford, A. L. Hallowell, L. E. Macomber. (1977). Failure of colostral immunoglobulin transfer as an explanation for most infections and deaths of neonatal foals. J Am Vet Med Assoc. 170: 1302-1304.

8. Nath, L. C., G. A. Anderson, C. J. Savage, A. O. McKinnon. (2010). Use of stored equine colostrum for the treatment of foals perceived to be at risk for failure of transfer of passive immunity. J Am Vet Med Assoc. 236: 1085-1090.
9. Radial, S. L. (1996). The incidence and consequences of failure of passive transfer of immunity on a thoroughbred breeding farm. Aust Vet J. 73: 201-206.
10. Robinson, J. A., G. K. Allen, E. M. Green, W. H. Fales, W. E. Loch, C. G. Wilkerson. (1993). A prospective study of septicaemia in colostrum-deprived foals. Equine Vet J. 25: 214-219.
11. Sanchez, C. (2014). Neonatal Sepsis. In: Equine infectious disease, 2nd ed. St. Louis: Elsevier. 70-77.
12. Sell, D. C, P. A. Wilkins. (2010). Failure of passive transfer. In: Equine internal medicine, 3rd ed. St. Louis: Elsevier. 1335-1336.
13. Sellon, D. C. (2000). Secondary immunodeficiencies of horse. Vet Clin equine. 16: 117-130.
14. Tizard, I. (1987). In: Veterinary immunology, An introduction 3rd ed. WB Saunders: Philadelphia, 171.
15. Tyler-McGowan, C. M., J. L. Hodgson, D. R. Hodgson. (1997). Failure of passive transfer in foals: incidence and outcome on four studs in New South Wales. Aust Vet J. 75: 56-59.
16. Vivrette, S. L. (2011). Assessment and modification of passive transfer. In: Equine reproduction, 2nd ed. West Sussex: Wiley-Blackwell. 346-352.
17. Wilkins, P. A., S. Dewan-Mix. (1994). Efficacy of intravenous plasma to transfer passive immunity in clinically healthy and clinically ill equine neonates with failure of passive transfer. Cornell Vet. 84: 7-14.

요약

이 연구는 최초의 국내 말에서 수동면역부전을 다룬 것이다. 이 연구의 목적은 건강한 말과 아픈 말의 면역상태를 비교하는 것이다. 수동면역부전은 말에서 가장 흔한 면역결핍질환이다. 아픈말 22 마리와 건강한 말 18 마리를 검사키트(SNAP Foal IgG Test Kit)를 이용하여 수동면역부전을 진단하였다. 모든 성마는 정상적인 면역기능을 가지고 있었다(≥800 mg/dℓ). 신생망아지는 22 마리 중 13 마리(59%; ∠800 mg/dℓ)가 면역기능이 취약하였지만 치료 후 회복하여 생존하였다. 이 22 마리 중 9 마리는 면역기능이 강한 말(≥ 800 mg/dℓ)로 혈중 IgG농도가 높아도 감염성 질환이 발생할 수 있다는 것을 보여준다. 폐사망아지는 모두 6 마리였고, 그중 4 마리는 감염성 질환이었다. 신생망아지 면역상태 검사를 통한 감염취약 정도의 조기진단 및 대응방안 마련으로 경주자원 활용율 제고와 보건관리 기술 향상을 도모할 수 있다. 또한, 신생망아지의 감염성질환 조기 파악으로 향후 육성마의 체계적인 보건 관리방안 마련에 일조할 수 있을 것으로 기대된다.

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