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Second-Degree Atrioventricular Block Observed in a Thoroughbred Foal on 2.5 Months of Age

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ABSTRACT. Electrocardiographic observation in 10 Thoroughbred horses has been carried out from fetal stages to 12 months after birth. In this observation a filly out of 10 foals at a resting state showed second-degree atrioventricular (A-V) block with sinus arrhythmia after 2.5 months of age. The number of dropped beats and the irregularity of sinus arrhythmia in these blocks were affected by the atrial rate, and several variations of Wenckebach phenomenon were shown under the influence of the atrial rate. Electrocardiographic characteristics of second-degree A-V block in the present filly might be similar to those observed more often in adult horses.—**KEY WORDS:** second-degree A-V block, sinus arrhythmia, Thoroughbred foal.

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Second-degree atrioventricular (A-V) block in adult Thoroughbred horses is not rare, but only few reports have been concerned with this symptom in the foals [1, 4, 12, 13]. Using 10 Thoroughbred foals (4 colts and 6 fillies born in the Stock Farm of University of Tokyo in 1981 or 1982), fetal and neonatal electrocardiograms (EKGs) at a resting state were traced periodically from day 190 of gestation to near term and from a few days after birth till 12 months of age. Normal EKGs from fetal through neonatal stages have been published [10, 11]. In this tracing, a filly out of 10 foals was found to show second-degree A-V block after 2.5 months of age (the remaining 9 foals did not show second-degree A-V block until 12 months of age). This present paper reports and discusses this Thoroughbred filly with second-degree A-V block.

Recording methods of fetal and neonatal EKGs have been reported previously [11]. Fetal heart rate (beats/min) was calculated from an EKG recorded for 20 min based on the mean beats per each 10 sec. Neonatal

heart rate (beats/min) of the foals without second-degree A-V block was determined by the mean duration of six successive RR intervals, while that of the filly with second-degree A-V block was by the number of QRS complexes for 1 min. In order to analyze characteristics of second-degree A-V block, the PP, PQ and QT intervals of about 100 consecutive heart beats were measured, and electrocardiographic characteristics of this A-V block were classified according to Holmes and Alps [7].

Changes in heart rate from fetuses through 12 months of age are indicated in Fig. 1. In the fetal stage, the heart rates of both the filly and the remaining foals decreased gradually with the advance in gestation with no significant difference in each other. However, the neonatal heart rate of the filly did not increase remarkably after birth and was always lower than those of the remaining foals. The fetal EKG and newborn EKGs till 2.5 months of age in this filly showed regular sinus rhythms as in the remaining foals.

Hamlin *et al.* [6] have mentioned that the

Fig. 1. Changes in fetal and neonatal heart rates under a resting condition. Fetal heart rate; a filly with second-degree A-V block (○) and remaining foals without second-degree A-V block (●). Neonatal heart rate; a filly before (○) and after (●) an appearance of second-degree A-V block and remaining foals (●). Points indicate means and vertical bars, if any, S.D. of 5 to 9 cases.

Fig. 2. EKGs of a filly at 2.5 months of age when second-degree A-V block was firstly detected. 5 dropped ventricular beats (●) per min were observed. Each panel is continuous tracing. PQ, QT and PP durations are shown in msec.

heart rate in adult horses is regulated only by the parasympathetic nerve. Our study using pony foals and dams indicated that the heart rate of adults at a resting state was regulated only parasympathetically, while that of new-

borns parasympathetically and sympathetically [11]. In the present filly after birth, parasympathetic activity might overcome sympathetic activity, because the neonatal heart rate was always lower than those of the

Table 1. Characteristics of second-degree A-V block in the filly at various ages

Age	Atrial rate (beats/min)	Dropped ventricular beats (beats/min)	Ventricular rate (beats/min)	PP interval(msec) variance	Wenckebach variation*
2.5 months	50	5	45	91.6	d, e
3	45	10	35	128.8	d, e
4	54	2	52	10.2	a
5	52	10	42	46.8	b, e
6	58	5	53	5.9	a
7	49	11	38	120.1	e
11	45	8	37	65.1	d, e
5 months**	55	0	55	5.1	
5**	57	0	57	3.6	
6**	58	0	58	5.1	

* Classification of Wenckebach phenomenon by Holmes & Alps (1966a).

** EKGs were recorded at unrest, second-degree A-V block disappeared.

Fig. 3. Correlations between atrial rate and either numbers of dropped ventricular beats or PP interval variance. The a, b, d and e show the variations of the Wenckebach phenomenon classified by Holmes & Alps (1966a). Data were derived from EKGs recorded under a resting condition (●) and an unresting condition (○).

remaining foals.

Fig. 2 indicates the EKGs of the filly at 2.5 months of age which showed the occurrences of second-degree A-V block. The atrial rate was 50 beats per min with 5 dropped ventricular beats. The PQ interval extended progressively until a beat was dropped in most cases but in a case illustrated in the bottom chart, the post-block PQ interval (52 msec) was not shorter than the pre-block PQ interval.

Electrocardiographic parameters and several variation of Wenckebach phenomenon on second-degree A-V block in the filly at various age are summarized in Table 1 and Fig. 3. The (a)-, (b)-, (d)- and (e)-types of Wenckebach variation presented by Holmes and Alps [7] were observable in the present filly, but the (c)-type was not found. In a range of 54 to 58 atrial rate per min, the PQ interval progressively increased until a beat was dropped and the post-block PQ interval was always shortened. The block occurring under these atrial rates was classified in the (a)-type, or the classical Wenckebach block, and the irregularity of sinus arrhythmia (PP interval variance) was small. In a range less than 52 atrial rate, in contrast, the post-block PQ interval was not shortened and the PQ interval of the third beat became the shortest. The

irregularity of sinus arrhythmia was larger. The block occurring under this atrial rate was classified in the (b)-, (d)-, (e)-types or their combinations. It is summarized that the number of beats dropped and the irregularity of sinus arrhythmia are affected by the atrial rate, and several variations of Wenckebach phenomenon are observed under the influence of the atrial rate. These results is attributed to the change in the tone of the vagus nerve.

Second-degree A-V block in this filly occurred when the atrial rate exceeded 45 beats per min. As the A-V block in adult horses occurs most frequently when the atrial rate is below 40 beats per min [7, 13], it can be said that second-degree A-V block in young horse appears at higher atrial rate than in adult horses.

It is generally recognized that second-degree A-V block in adult horses can be eliminated by a small dose of atropine or exercise and that this block is resulting from vagal activation [2-5, 7, 8, 12-15]. As shown in Table 1 and Fig. 3, two additional electrocardiographic observations in this filly at 5 and 6 months were carried out under some unresting conditions induced experimentally, by making walk for a short period or putting on light at midnight. Under these unresting conditions, both second-degree A-V block and sinus arrhythmia disappeared. It was considered that the tone of the vagus nerve lowered at the unresting state, therefore both second-degree A-V block and sinus arrhythmia were eliminated. In addition, the T wave configuration in the present filly after A-V block changed into the form as reported in adult

horses [1, 2, 4, 5, 7-9, 12].

From electrocardiographic observations, it is considered that the filly might share a similar cause with adult horses for the occurrence of second-degree A-V block.

REFERENCES

1. Amada, A., and Senta, T. 1964. *Exp. Rep. Equine Hlth Lab.* No. 2: 9-27 (in Japanese).
2. Brooijmans, A. W. M. 1957. Electrocardiography in horses and cattle. Theretical and clinical aspects. pp. 102-153. Uitgeverij Canteleer. Utrecht.
3. Buchanan, J. W. 1965. *Ann. New York Acad. Sci.* 127: 224-238.
4. Detweiler, D. K., and Patterson, D. F. 1963. In: *Equine Medicine and Surgery*, 1st ed., pp. 368-397. American Veterinary Pub., Inc., Wheaton, Illinois.
5. Fregin, G. F. 1982. In: *Equine Medicine and Surgery*, 3rd ed., pp. 645-704. American Veterinary Pub., Drawer KK, Santa Barbara, California.
6. Hamlin, R. L., Klepinger, W. L., Gilpin, K. W., and Smith, C. R. 1972. *Am. J. Physiol.* 222: 976-978.
7. Holmes, J. R., and Alps, B. J. 1966a. *Can. Vet. J.* 7: 280-290.
8. Holmes, J. R., and Alps, B. J. 1966b. *Vet. Rec.* 78: 672-683.
9. Lannek, N. 1951. *Nord. Vet. -Med.* 3: 425-434.
10. Matsui, K., Amada, A., Sawasaki, T., and Kano, Y. 1983. *Bull. Equine Res Inst.* No. 20: 79-88.
11. Matsui, K., Sugano, S., Masuyama, I. Amada, A., and Kano, Y. 1984. *Jpn. J. Vet. Sci.* 46: 505-510.
12. Smetzer, D. L., Senta, T., Smith, C. R., and Cromer, D. B. 1968. *Am. J. Vet. Res.* 30: 337-343.
13. Smetzer, D. L. Smith, C. R., and Senta, T. 1969. *Am. J. Vet. Res.* 30: 933-946.
14. Spörri, H. 1952. *Schweiz. Arch. Tierheilk.* 94: 337-346.
15. Vibe-Petersen, G., and Nielsen, K. 1980. *Nord. Vet. -Med.* 32: 105-121.

要 約

サラブレッド幼駒にみられた第2度房室ブロックについて(短報): 松井寛二・天田明男¹⁾・沢崎 坦(東京大学農学部附属牧場, ¹⁾日本中央競馬会競走馬総合研究所)——サラブレッド10頭の心電図を胎生期から出生後12カ月まで追跡したところ, 雌馬1頭は生後2.5カ月齢以降に洞性不整脈をとまう第2度房室ブロックを示した。この例のブロック時の心室収縮脱落数, 洞性不整脈の程度ならびに Wenckebach 周期の様式は心房拍数に対応していた。このような幼駒の第2度房室ブロックの心電図学的特徴は, 成馬にしばしばみられるものと同様であった。