New Criteria for Canine Metabolic Syndrome in Japan

[1]Koh Kawasumi, [2]Tomoko Suzuki, [1]Megumi Fujiwara, [1]Nobuko Mori,
[1]Ichiro Yamamoto and [1]Toshiro Arai
[1]Department of Veterinary Science, School of Veterinary Medicine,
Nippon Veterinary and Life Science University,
1-7-1 Kyonancho, Musashino, 180-8602 Tokyo, Japan
[2]Faculty of Veterinary Technology, Yamazaki Gakuen University,
4-7-2 Minami-osawa, Hachiouji, 192-0364 Tokyo, Japan

Abstract: Researchers attempted to establish temporary criteria for Metabolic Syndrome (MS) diagnosis in dogs. To verify the usefulness of the selected criteria, researchers measured plasma Glucose (GLU), Triglyceride (TG), Total Cholesterol (TC), Non-Esterified Fatty Acid (NEFA), Alanine Aminotransferase (ALT) and insulin levels as diagnostic markers in 105 clinically healthy dogs. Dog with obesity as an essential factor (BCS = 3.5) in addition to any two of the following three factors 1-3 namely increased plasma GLU levels ($\geq$120 mg dL^{-1}), hyperlipidemic condition, diagnosed with any two of the following three factors, elevated TG ($\geq$165 mg dL^{-1}), TC ($\geq$200 mg dL^{-1}), NEFA ($\geq$1.5 m Eq^{-1}) levels and higher ALT activit ($\geq$100 IU L^{-1}) were diagnosed as MS. Presence of additional factors such as raised insulin levels ($\geq$2.5 ng mL^{-1}), confirmed the MS diagnosis. Based on these criteria, 13 (12.9%) of 101 dogs were diagnosed as MS. In these dogs, NEFA, TC and ALT levels were significantly higher than those in the control dogs (n = 88) without MS. MS was not detected in dogs with Body Condition Score (BCS)<3.

Key words: Dog, metabolic syndrome, obesity, diagnosis, Japan

INTRODUCTION

In human, change in Western lifestyle are thought to be responsible for the rapid rise in obesity and type 2 diabetes mellitus and epidemiological evidence strongly suggests that changes in diet and levels of physical activity are the main contributory lifestyle factors (Tuomilehto *et al.*, 2001; Emberson *et al.*, 2005). Obesity is associated with insulin resistance and the Metabolic Syndrome (MS). MS is a cluster of the most dangerous heart attack risk factors: diabetes and raised fasting plasma glucose, abdominal obesity, high cholesterol and high blood pressure (IDF, 2005). It is estimated that around 20-25% of the world's adult population have MS and they are twice as likely to die from and three times as likely to have a heart attack or stroke compared with people without the syndrome (Stern *et al.*, 2004).

In dogs and cats, occurrence of glucose and lipid abnormality with obesity has increased markedly in recent years (Johnson, 2005; Mori *et al.*, 2010; Hatano *et al.*, 2010). It has been estimated that prevalence of overweight and obese dog is 24-30% (Burkholder and Toll, 2000). In the earlier study, researchers have proposed the temporary criteria for MS diagnosis in cats and nine of 50 (18%) cats have been diagnosed with MS (Mori *et al.*, 2012). In this study, researchers tried to establish new temporary criteria for MS in dogs and verified by comparing with value in healthy dogs.

MATERIALS AND METHODS

One hundred one client owned (volunteered) dogs (56 female, 45 male, 2-15 years old) of 5 veterinary clinics in Kanto district in Japan were used to evaluate the criteria for MS diagnosis. The degree of obesity was assessed by Body Condition Score (BCS) on the following five point scale: very thin, underweight, ideal, over weight and obese. Blood samples were taken from jugular veins of dogs fasted overnight (without any nutrient for >8 h after the last meal) in heparinized tubes. Plasma was recovered by centrifugation at 4°C and stored at -25°C until use. Glucose (GLU), Triglyceride (TG), Total Cholesterol (TC), Alanine Aminotransferase (ALT) were measured using an autoanalyzer (AU680, Beckman Coulter, CA, USA) with manufacture's reagents. Plasma Insulin (ISN) concentrations were measured with

Corresponding Author: Koh Kawasumi, Department of Veterinary Science, School of Veterinary Medicine,
Nippon Veterinary and Life Science University, 1-7-1 Kyonancho, Musashino, 180-8602 Tokyo, Japan

commercial ELISA kits, Lbis dog insulin kit (Shibayagi Co., Gunma, Japan) Non-Esterified Fatty Acid (NEFA) was measured using commercial kit (NEFA-C test, Wako Pure Chemical Industries, Inc., Tokyo, Japan). Results are presented as mean ±95% CI. Statistical significance was determined by Student's t-test. The significance level was set at p<0.05.

RESULTS AND DISCUSSION

The temporary criteria for MS diagnosis in dogs are discussed in the study. Temporary criteria for Metabolic Syndrome (MS) diagnosis in dogs to be defined as having MS, dogs must have the following:

- Central obesity (BCS ≥3.5) and any two of the following 3 factors, 1-3)
- Plasma GLU levels ≥120 mg dL^{-1}
- Hyperlipidemic condition, diagnosed with any two of the following three factors, TG ≥165 mg dL^{-1}, TC ≥200 mg dL^{-1}, NEFA ≥1.5 m Eq^{-1} levels
- ALT level ≥100 IU L^{-1}. MS is confirmed by insulin levels ≥2.5 ng mL^{-1}

The effect of canine obesity has been studied since at least 1960's (Finlayson *et al.*, 1960; Krook *et al.*, 1960). Today, abdominal obesity due to visceral fat accumulation with insulin resistance seems to be an important risk factor for MS in dogs as well as in humans. In this study, researchers tried to establish the temporary criteria for MS diagnosis in dogs. Based on the new criteria, thirteen (12.9%) of 101 dogs were diagnosed as MS. In MS dogs, plasma NEFA, TC and ALT levels were

significantly higher than those in control dogs without MS. Plasma TG and insulin levels in the MS dogs were higher than those in controls whereas remarkable difference of plasma glucose levels between dogs with MS and dogs without MS were not detected (Table 1). The occurrence ratio of MS was investigated in dogs with different BCS and ages (Table 2). All thirteen dogs diagnosed as MS were observed in dogs with BCS ≥3.5.

CONCLUSION

Since, development of MS causes severe metabolic syndrome such as diabetes mellitus, proper treatment such as food restriction and exercise, appears to be a key factor to prevent the progression to severe metabolic disorders. The criteria presented here for dogs are not absolute and should be adjusted based on further examination of additional data to be confirm as reliable.

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Table 1: Comparison of metabolite, enzyme and hormone levels in dogs with and without Metabolic Syndrome (MS)

Parameters	With MS (n = 13)	Without MS control (n = 88)
Glucose (mg dL^{-1})	117.00±14.00	101.9±7.300
TG (mg dL^{-1})	141.90±102.7	95.6±23.60
NEFA (mEq L^{-1})	1.36±0.630*	0.78±0.18
TC (mg dL^{-1})	254.20±43.80*	204.7±13.30
ALT (IU L^{-1})	137.60±78.80*	52.3±7.500
Insulin (ng mL^{-1})	2.27±1.430	1.89±0.34

Values are presented mean±95% CI. *Significantly different (p<0.05) from control dogs values

Table 2: Occurrence ratio of metabolic syndrome in dogs with various body condition score or age

Parameters	Ratio of metabolic syndrome (%)
BCS	
<3	0/2 (0.0)
3-4	11/85 (12.9)
>4	2/14 (14.3)
Age	
1-4 years old	3/14 (21.4)
5-10	5/59 (8.5)
>10	5/28 (17.9)

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