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Thermographic Evaluation of Healing Process of Experimentally Induced Infectious Arthritis in Horses

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Abstract : This study was carried out to assess the usefulness of thermography for diagnosis and healing process of musculoskeletal disorder in horses. Horses with experimentally induced infectious arthritis were treated with bee venom or antibiotics for 5 weeks from 24 hours after inoculation of *Staphylococcus aureus*, the effectiveness of the 2 therapeutic drugs treatment was similar to each other. Thermographic evaluation was similar to any other tests, because the thermal pattern tend to return to normal with declining similar to those of clinical signs, laboratory experiments and healing of the lesion. This ability to assess inflammatory change noninvasively make thermography an ideal imaging tool to aid in the diagnosis of certain lameness condition or musculoskeletal disease in horses. These results suggested that thermographic evaluation in horses with musculoskeletal disorders were useful for diagnosis and helpful for monitoring of healing process.

Key words **:** thermographic evaluation, horse, lameness diagnosis, infectious arthritis, healing process.

Introduction

Musculoskeletal disease is one of the important areas of veterinary medicine in horses regardless of its breed (over 200 different breeds) and purpose (such as racing, riding and hunting horses). In order to diagnose and treat horses clinically, detailed physical examination is essential. However, the high rate of musculoskeletal disease in horses requires accurate diagnosis and prognosis evaluation so that various methods and tools have been developed to make early diagnosis for damage and evaluate prognosis (17,19).

Conventional methods of making diagnosis include gait evaluation, joint flexion test, nerve block using local anesthetic. Imaging techniques include radiography to evaluate bones and joints; ultrasonography for soft tissues such as tendon and ligament; and CT or MRI for bone cross-sections. Arthroscopy and a fluorescent probe are used together for the diagnosis of fracture and to facilitate surgery.

In recent years, other imaging techniques have been used in clinical settings including nuclear scintigraphy detecting changes in bone and new bone formation by observing an increased absorption of isotopes in soft tissues/bone and thermography expressing body temperature into images. These techniques provide the way to find swellings not shown with other imaging techniques and ordinary clinical tests. So, they give information that could clealy elucidate prognosis and treatment, and enable following up with the process of recovery or progression of disease, playing an important role in the diagnosis of musculoskeletal disease (15,20). Nonetheless, the use of these imaging tools is not feasible in most on-site clinical situations since they require a large space, are expensive to install, and only provide anatomical and pathological information. Although there are some clinical limitations in the effectiveness of thermography due to interference from outside factors and its inability to confirm accurate swellings, it also provides physiological information, which can be effective when used in conjunction with other clinical tests or imaging tools (19). Most clinicians and animal owners could determine continuity of the treatment, rather than a simple diagnostic function.

In this study, the healing progress was analyzed based on the clinical, laboratory, radiographic, and thermographic results obtained from horses with expreimentally induced infectious arthritis to evaluate the value of thermography as a diagnostic method for musculoskeletal disease focusing on the results from the various tests that are currently used with arthritis.

Materials and Methods

Experimental animal

We examined 4 healthy horses being raised at the Jeju stud farm in Korea Racing Association. Each horse was placed in a small field attached with a stable. They were thoroughbreds with their average weight being 505 kg (ranging from 482 to 541 kg). And they were divided with bee venom treated group

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(2 horses) and antibiotics treated group (2 horses) throughout study.

Arthritis induction and diagnosis

Staphylococcus aureus (SA, CNUH12) was used to induce arthritis. In order to increase its activity, the strain kept at -70°C in glycerol solution was subcultured in brain heart infusion agar (Difco) containing 7% sheep blood. After the cultured strain was washed in physical saline solution and centrifuged, 200 μl of final product containing 1.6×10^6 CFU (colony forming unit) was inoculated into the carpal joint of the right forelimb using a 26G, 2" needle. Infectious arthritis was diagnosed based on the clinical signs, bacterial culture, and results of laboratory and radiographic findings.

Drugs

Four horses were divided into group 1 and group 2 in pairs which group 1 was treated with dry bee venom (Apitoxin, Guju Pharma Co. LTD, Korea) and group 2, antibiotics (Fortecilline, Bayer, Korea). Each drugs were diluted with distilled water before injection. Dry bee venom was injected into the carpal joint cavity at 0.168 ß² per 100 ß³ body weight twice a week for 5 times. Antibiotics were injected into intramuscularly for 5 weeks at 1.2 million IU per day.

Evaluation of clinical signs

All data for clinical signs were evaluated 5 times, ie., before bacteria inoculation into the carpal joint, at the time of bacteria inoculation, and 10, 20 and 30 days after treatment. The degree of lameness was evaluated using the method proposed by Stashak (20) by placing lameness into 4 classes. In class 1, lameness is observed when the horse is trotting not when walking. In class 2, forelimb lameness is shown when the horse is walking but no head movement is shown, whereas the head and neck are definitely moving when trotting. In class 3, lameness is distinct when the horse is both walking and trotting. In class 4, the horse could not bear its own weight.

Swelling was evaluated using the method used by White *et al.* (28,29), in which the degree of swelling at the carpal joint was evaluated by measuring the carpal circumference and classifying the length into 4 grades from 1 to 4 inches.

The degree of pain was evaluated using the method used by White *et al.* (28,29) in which the degree of carpal flexion was classified into 4 grades.

The degree of heat was evaluated by comparing heat in the dorsal section of the carpal joint in the right and left sides using the palm and classifying the degree of heat into 4 grades.

Total WBC

Blood samples were taken 5 times, ie., before bacteria inoculation into the carpal joint, at the time of bacteria inoculation, and 10, 20 and 30 days after treatment, respectively. These samples were kept in an anti-coagulatory container treated with EDTA and the hematological values were analyzed using a blood analysis apparatus (HEMAVET 900, Japan).

Total protein and transferase activity in synovial fluid

Synovial fluid analysis was performed using a blood analyzer (Dri-Chem, Japan) on the same days of blood tests from the right carpal joint which was sterilized, a needle was inserted into the middle portion of the carpal joint and attached to a needle holder to collect synovial fluid, which was placed in a container treated with anticoagulants to analyze total protein and transferase activity.

Bacterial culture

Synovial fluid was cultured and analyzed to determine the presence of *Staphylococcus aureus* in the carpal joint cavity on the same days of synovial analysis according to infection with the use of the bacteria and treatment.

Radiography

In order to observe changes in soft and bone tissues within the carpal joint of the forelimb before collection of synovial sample on the same days of synovial analysis, radiography was taken from the dorsal-palmar view and the latero-medial view at 65 kVp and 16 mAs from 1 m distance and at 65 kVp and 13 mAs from 1 m distance, respectively, on each testing data.

Thermography

Thermography was perfomed using IR 2000 (Korea). For thermography, each horse was moved to an individual stable next to the field to adopt to the environment for 10-20 minutes. The horse was then moved to the room for thermographic examination where the horse was allowed an additional 10 minutes with the room kept at comfortable without breeze (19~22°C at 16~30% humidity). And thermographic images were taken from the both carpal joints to record skin temperature differences, they were taken 5 times, ie., before bacteria inoculation into the carpal joint, at the time of bacteria inoculation, and 10, 20 and 30 days after treatment, respectively.

Results

Changes in clinical signs

Table 1 shows the clinical changes related with lameness, swelling, pain, and heat during the study period. Severe swelling, pain, and lameness accompanied by moderate heat were shown within 24 hours after bacterial inoculation into the carpal joint in all horses. In group 1 treated with bee venom (horse No. 1 and No. 2), swelling and pain were recovered slowly or fluctuated with treatment and lameness and heat were recovered slowly. Compared with In group 1 treated with bee venom, group 2 treated with antibiotics (horse No. 3 and No. 4) showed faster recovery related with lameness, pain and heat other than swelling. Lameness was somewhat

Table 1. Changes of index of the clinical signs after administration of therapeutic drugs

		Lameness					Swelling					Pain					Heat				
Horse number*		1	2	3	4	ave.**	1	2	3	4	ave.	1	2	3	4	ave.	1	2	3	4	ave.
Pre treatment		0***	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Infection		4	4	4	4	4	2	3	2	4	3	4	4	2	4	4	3	2	2	2	2
Post-treatment (days)	10	3	3	2	2	3	3	3	3	4	3	2	3	2	2	2	2	2	1	2	2
	20	2	3	1	1	2	4	4	2	3	3	3	2	1	1	2	2	1	1	1	1
	30	1	2	1	1	1	3	4	2	2	3	2	2	0	0	1	0	0	0	0	0

*Bee venom treatment; horse No. 1 and No. 2, Antibiotics treatment; horse No. 3 and No. 4.
**Degrees; 0(negative), 1(light), 2(moderate), 3(severe) and 4(most severe)
***Average of degree of clinical signs

valuable for the evaluation of prognosis with treatment in both group 1 and group 2. On the other hand, swelling did not change significantly during the healing process. Pain and heat did not show much change, suggesting that these signs have a little value for the evaluation of prognosis with treatment.

Changes in total WBC and total protein and AST in synovial fluid

Table 2 shows changes in total WBC range and those in total protein (TP) range and the aspartate aminotransferase (AST) activity during the course of treatment. Before bacterial inoculation into the carpal joint, the range of total WBC in four horses of 2 groups, ie., group 1 (horse No. 1 and No. 2) and group 2 (horse No. 3 and No. 4), was an average of 7,100 (4,000~9,300) cells/μl, covering a wide range within the normal range. In the early stage of infection, ie., one day after bacterial inoculation, the range of total WBC was twice as high compared with before bacterial inoculation, ie, 13,100 (9,000~18,000) cells/μl, which was the highest in each horse during the course of study. During the course of treatment, it was decreased gradually only 1 case (horse No. 1), whereas it fluctuated in the other 3 cases (horse No. 2, No. 3 and No. 4). It dropped to normal range with both treatments.

The range of TP in synovial fluid showed an average of 2.2 (1.4~2.8) g/dl before bacterial inoculation. It was somewhat high during the study period in the early stage of infection, ie., at an average of 6.0 (5.5~6.6) g/dl. It was decreased gradually in 1 bee venom treated case (horse No. 2) and 1 case treated with antibiotics (horse No. 4). It fluctuated in the other 2 cases (horse No. 1 and No. 3) and gradually decreased later.

The activity of aspartate aminotransferase (AST) in synovial fluid was normal before bacterial inoculation, ie., at an average of 113 (79~176) U/l. It was increased significantly in the early stage of infection, ie., at an average of 290 (242~394) U/l. It fluctuated in both bee venom and antibiotic treated horses during the course of treatment. However, it decreased to the normal range at the end of treatment which was 156 (110~223) U/l in average.

Bacterial culture using synovial fluid

Table 3 shows the results of bacterial culture of synovial fluid. No bacterial growth was shown in synovial fluid before bacterial inoculation in all horses. *Staphylococcus aureus* was detected in all 4 horses after the initial bacterial inoculation. Bacterial growth was seen in synovial fluid of one horse out

Table 3. Changes of bacterial culture of synovial fluid after administration of therapeutic drugs

		Bee venom		Antibiotics	
Horse number		1	2	3	4
Pre treatment		−*	−	−	−
Infection		+**	+	+	+
Post-treatment (days)	10	+	−	−	+
	20	−	−	−	−
	30	−	−	−	−

*Not exist *Staphylococcus aureus*
**Exist *Staphylococcus aureus*

Table 2. Changes of total white blood cell (WBC), total protein (TP) concentration and aspartate aminotransferase (AST) activity in synovial fluid after administration of therapeutic drugs

		Blood					Synovial fluid									
		Total WBC (10^3/μl)					TP (g/dl)					AST (U/l)				
Horse number*		1	2	3	4	average	1	2	3	4	average	1	2	3	4	average
Pre treatment		8.2	4.0	6.9	9.3	7.1	2.8	1.4	2.4	2.1	2.2	100	97	79	176	113
Infection		11.7	18.0	9.0	13.6	13.1	6.1	6.6	5.7	5.5	6.0	243	394	242	282	290
Post-treatment (days)	10	9.9	15.1	7.3	8.1	10.1	6.3	5.8	5.4	5.1	5.7	239	30	27	28	81
	20	9.1	8.7	8.1	6.8	8.2	7.8	4.6	5.6	3.8	5.5	259	186	289	191	231
	30	8.5	9.7	8.0	8.3	8.6	5.2	4.0	4.4	2.8	4.1	152	140	223	110	156

*Bee venom treatment: horse No. 1 and No. 2. Antibiotics treatment: horse No. 3 and No. 4.

of each group (horses No. 1 and No. 4) on 10 days of treatment. It was not seen in all horses on 20 and 30 days of treatment with both bee venom and antibiotics.

Radiographic changes

Before bacterial inoculation, no changes were observed in soft tissues such as swelling and bony tissues including the periosteum in all horses. On 1 day of bacterial inoculation, severe swelling was observed at the knee. The swelling of soft tissues decreased gradually in all cases, although differing in each horse, on 10 to 30 days of treatment(Figs 1 and 2).

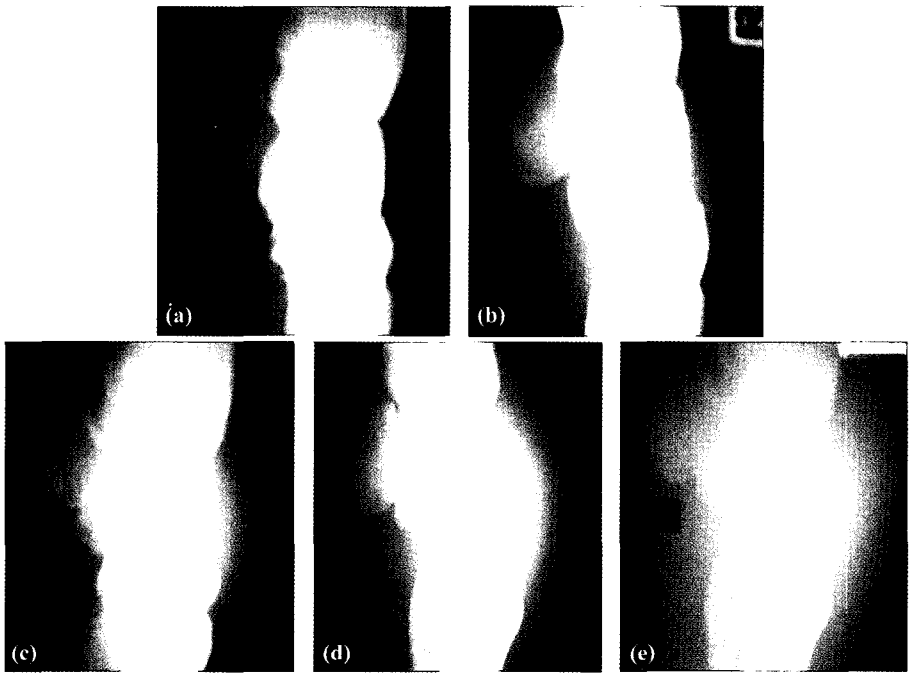

Fig. 1. Radiographic changes of the carpal joint in the horse No. 1 of group 1 (latero-medial view). (a) normal joint, (b) infectious arthritis, (c), (d) and (e) 10, 20 and 30 days after treatment, respectively.

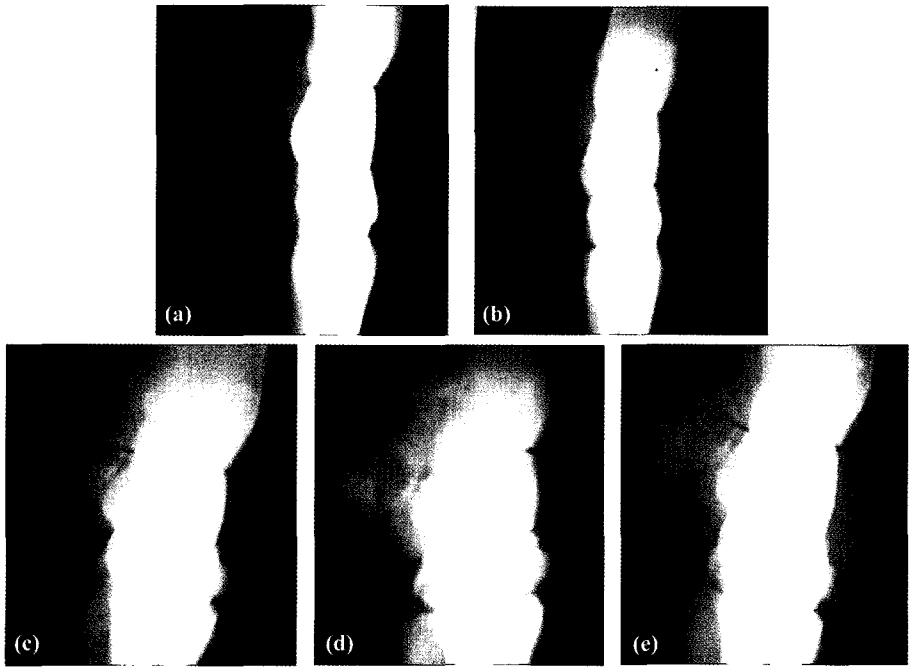

Fig. 2. Radiographic changes of the carpal joint in the horse No. 3 of group 2 (latero-medial view). (a) normal joint, (b) infectious arthritis, (c), (d) and (e) 10, 20 and 30 days after treatment, respectively.

Table 4. Changes of temperature difference(ΔT,°C) after administration of therapeutic drugs

		Bee venom		Antibiotics		Average
Horse number		1	2	3	4	
Pre treatment		0.15*	0.05	0.33	0.09	0.16
Infection		1.28	2.09	0.85	1.54	1.44
Post-treatment (days)	10	1.47	1.26	0.82	0.98	1.13
	20	1.17	1.25	1.09	2.74	1.56
	30	0.76	0.45	0.68	0.78	0.67

*Temperature difference(ΔT, °C) between both forelimbs

Thermographic changes

Table 4 shows temperature differences(ΔT) at the anterior portion of the carpal joint in the forelimb. Before bacterial inoculation, the average temperature difference between the right and left carpal joints was 0.16(0.05~0.33)°C. On 1 day of bacterial inoculation, ΔT was 1.28 and 2.09°C in each horse treated with bee venom. It was the highest in horse No. 1 on 10 days of treatment and deceased later. In horse No. 2, it was decreased during the course of treatment. By the end of treatment, it was recovered to normal to 0.76°C and 0.45°C in horse No. 1 and No. 2, respectively.

On the other hand, ΔT was 0.85 and 1.54°C in each horse (horse No. 3 and No. 4) treated with antibiotics, on 1 day of treatment respectively. On 10 days of treatment, it was decreased to 0.82 and 0.98°C, respectively, but fluctuated up to 1.09 and 2.74°C, respectively, on 20 days of treatment. It was decreased again on 30 days of treatment to 0.68 and 0.78°C, respectively (Fig 3 and 4).

Discussion

Infectious arthritis arising from joint infection is a very serious disease destroying joints in horses where the affected joint is destroyed quickly or bone necrosis occurs at the joint (11,13). *Enterobacteraceae*, Streptococci, and *Staphylococci* are typically found in these affected joints. *Staphylococcus* is the most likely strain causing endogenous infection. Diagnosis can be confirmed using clinical signs, hematologic findings, synovival fluid analysis, bacterial culture, and radiographic findings. Treatment is done using broad-spectrum antibiotics, joint lavage, anti-inflammatory drug injection, and sodium hyaluronate injection into the affected joint after surgery (2,3, 11,13). In this study, infectious arthritis was induced in 4 horses. We used two different agents for the treatment of infectious arthritis, ie., bee venom, which was reported to have high anti-inflammatory and anti-bacterial activities by many researchers (4,9,10) in recent years, and penicillin products (11,12,22). And we injected the recommended doses by the manufactures, among different broad-spectrum or local antibiotics used for the treatment of infectious arthritis. These two agents showed similar treatment results, so we analyzed each item, focusing on the evaluation of prognosis according to the healing process.

In this study, we evaluated prognosis after treating experimentally induced infectious arthritis using bee venom and

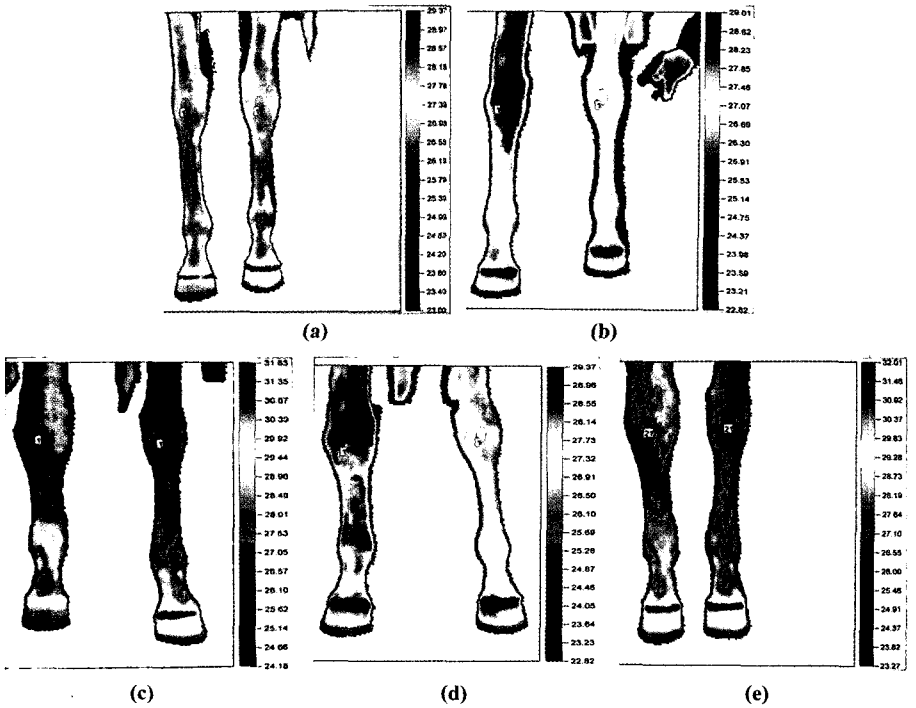

Fig. 3. Thermographic changes of the carpal joints in the horse No. 1 of group 1. (a) normal joint, (b) infectious arthritis, (c), (d) and (e) 10, 20 and 30 days after treatment, respectively.

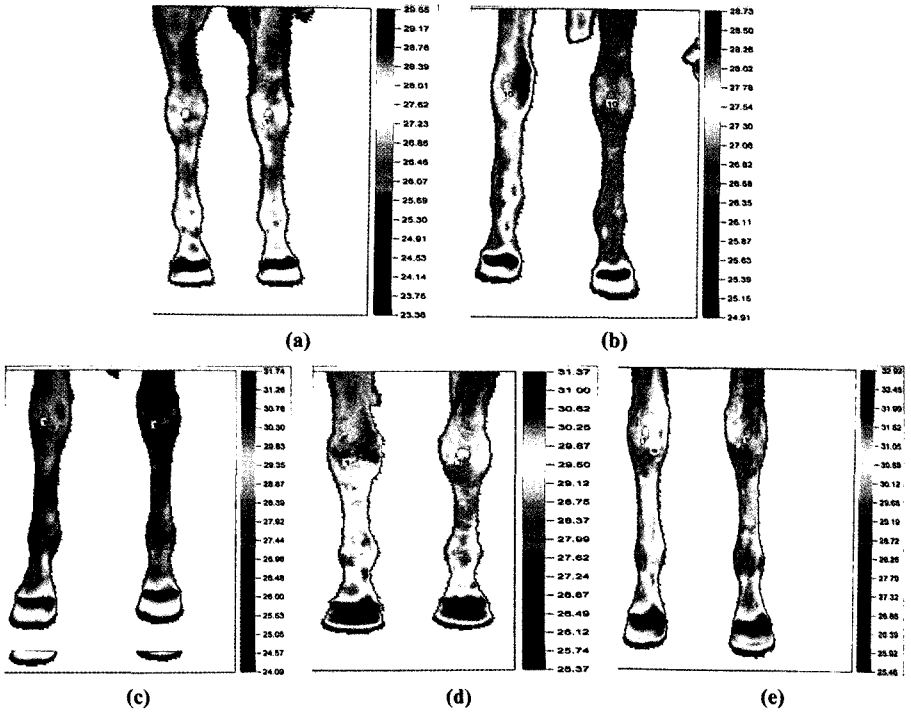

Fig. 4. Thermographic changes of the carpal joints in the horse No. 3 of group 2. (a) normal joint, (b) infectious arthritis, (c), (d) and (e) 10, 20 and 30 days after treatment, respectively.

antibiotics. Among different means of evaluating prognosis, clinical signs were evaluated subjectively, and effective to rate prognosis. However, only lameness showed significance for diagnosis and prognosis. Swelling, pain and heat at the site of infection were helpful in the diagnosis of infection but were not effective for the evaluation of prognosis. It seemed that synovial fluid sampling and treatment of the joint cavity using needles damaged the joint, affecting adversely for the evaluation of clinical signs.

For accurate diagnosis, laboratory findings are essential in horses and should be evaluated along with clinical tests and physical examination (5). Bertone (3) reported that hematologic tests, synovial fluid analysis, synovial fluid culture and radiography are required for a systematic diagnosis of infectious arthritis. Among laboratory findings, changes in WBC are important to evaluate hematologic changes. The average number of WBC was 7,100(4,000~9,000) cells/μl in 4 horses before bacterial inoculation. It was increased to almost two folds compared with the normal range on 1 day of bacterial infection. It was decreased normal range with treatment in most horses. Thus, the range of total WBC in blood is effective in the evaluation of bacterial infection and treatment results.

Synovial fluid is a serum filtrate with increased osmosis in the synovial membrane (22). The range of protein in synovial fluid within the joint increases when infection occurs. The normal range of total protein (TP) in synovial fluid was reported to be different according to authors from less than 1 g/dl (14,23), less than 2 g/dl (1,12), and less than 2.5 g/dl (11,22). It will increase to higher than 4 g/dl in the presence of experimentally induced or naturally occured infectious arthritis and severe infection (2,12,22). On the other hand, van Pelt (27) reported that TP is similar in synovial fluid and serum in acute state, but increases significantly in the presence of infectious arthritis. Bertone (2) reported that TP was 5.6 g/dl on the day of induced infection. Tulamo *et al.* (24) stated that it was 4.6~5.8 g/dl on 1 day of bacterial infection. In 4 horses of this study, the average TP before bacterial infection was 2.2 g/dl and increased to an average of 6.0 g/dl on 1 day of infection. TP in synovial fluid was either increased or decreased in each horse with treatment. however, it was decreased in all 4 horses on 30 days of treatment, suggesting that TP is helpful in observing the joint status.

Enzyme activities in synovial fluid are responsible for changed metabolism in the synovial membrane or joint cavity. Thus, the activity of aspartate aminotransferase (AST) will increase significantly when the joint prove infectious arthritis. The range of AST activity is 25±4 (2~34) U/l in normal horses, whereas it is 57±30 (36~91) U/l in horses with infectious arthritis (5,8,27). In this study, the average of AST activity was relatively high as 113 (79~176) U/l before bacterial infection. It was significantly increased to 3-folds compared with the normal range on 1 day of infection. Thus, AST activity was effective in diagnosing joint infection. As in other clinical and laboratory findings, it fluctuated during the treatment in all horses. However, it was decreased to normal range at an average of 156 (110~223) U/l on 30 days of treatment. Thus, the activity of a certain enzyme within the joint will be effective to evaluate treatment outcome.

Bacterial culture of synovial fluid is useful for the selection of antibiotics and management of infectious arthritis. Infectious arthritis is diagnosed when bacterial culture of synovial fluid yields a positive result. Even in the presence of bacterial infection in the joint, it sometimes yields a negative result in about 50% of the cases due to sample contamination, small quantity of the causal agent, lagging virulence, joint defense mechanism and antibiotic treatment (1,2,11-13,21,22,24). According to the results of this study, bacterial culture yielded a negative result in all horses before bacterial infection and *Staphylococcus aureus* was found in all horses at 100% on 1 day of bacterial infection. Bacterial culture was positive in 50% of the cases (1 horse in each group, ie., horse No. 1 and No. 4) on 10 days of treatment using bee venom and antibiotics. Similar to the result found by other authors, it was negative in all horses on 20 days and 30 days of treatment, suggesting that bacterial culture is effective in a limiting way for the diagnosis and treatment evaluation of infectious arthritis.

Radiography provides useful information in acute disease and is recommended for the removal of joint lesions related with fractures by examining bone or marrow infection, since bone damages such as marrow narrowing and periosteal proliferation would occur (12,18). On the other hand, Moyer (14) and van Pelt (27) recommended radiography to find additional complications but also stated that joint cavity damage is not seen clearly on radiographs so that there is no consistent relationship in changes between radiographic and clinical findings.

We took radiography from the dorsal-palmar view and latero-medial view to determine the presence of soft tissue swelling, bone erosion and new bone formation in all horses. However, we could not observe any specific bony changes due to bacterial infection in all horses. Thus, we concluded that radiography offers a limited use for the diagnosis and treatment evaluation of infectious arthritis.

Thermography measuring the amount of infrared emitted by the skin is used to diagnosis infection, observe treatment progression, and measure temperature changes on the skin by quantifying heat, which is one of the important signs of infection (6,7,25). Purohit and McCoy (16) reported that thermography is effective for the quantitative and qualitative evaluation of treatment course in experimentally induced infection. The results of the present study showed that the average temperature difference at the anterior portion of the carpal joint between the left and right knees in all 4 horses was 0.16 (0.05~0.33)°C before bacterial infection. When infectious arthritis was diagnosed through clinical, laboratory and bacterial culture findings, ie., 1 day after bacterial inoculation, the temperature was somewhat different at the right carpal joint according to each horse. However, the average temperature at the right carpal joint, the side not inoculated with bacteria, was 1.44 (0.85~2.09)°C higher than the left side. Temperature difference between the right and left side fluctuated in 3 horses during the course of treatment until 20 days of treatment, except in 1 horse (horse No. 2) that was treated with bee venom, in which temperature difference was gradually decreased. By the end of treatment, ie., on 30 days of treatment, the average temperature difference between the left and right sides was similar to that before bacterial inoculation, ie., 0.67 (0.45~0.78)°C, showing recovery. Temperature difference fluctuated during the course of treatment probably due to the frequent insertion of needles to obtain samples for clinical, laboratory and synovial fluid evaluation and individual difference for the treatment. On the other hand, the maximum temperature difference at the carpal joint between the left and right sides was 0.33°C before bacterial inoculation. The minimum and maximum temperature differences were 0.82°C and 2.74°C, respectively, in infected state on 1, 10 and 20 days of infection. These temperature differences were lower in the normal state but higher in the infected state, compared with the maximum temperature difference between the left and right sides in normal horses, at 0.74°C reported by Yang *et al.* (30) who examined thermographic findings in the musculoskeletal system in the lower limbs in horses. Thus, we believe that thermography is effective for the evaluation of prognosis in musculoskeletal disease in horses by enabling the clinician to determine the time of terminating treatment through the observation of treatment course. However, Turner (26) recommended a careful interpretation of thermographic findings for the evaluation of diagnosis, despite the potential value of thermography since thermographic results do not agree with the findings of other tests.

According to the results of this study, thermographic findings were somewhat different from clinical, laboratory and radiographic findings during the course of treatment, other than the normal state, ie., before bacterial infection, and by the end of treatment, ie., 30 days of treatment. However, they were similar to hematologic and synovial fluid findings, which are considered objective for diagnosis and the evaluation of treatment outcome in infectious arthritis, suggesting that thermography is effective for disease diagnosis and treatment outcome evaluation. Thermography shows whether treatment is completed in damaged tissues even when clinical and laboratory findings tell otherwise; thus, it would significantly aid in the observation of treatment course and the evaluation of treatment and prognosis when used frequently. This technique is a good technique supplementing clinical tests and radiography. It can even substitute some clinical tests according to disease types and lesion sites and supplement other imaging techniques. Thus, thermography is recommended in large animal practice such as in horses in the field of veterinarian medicine.

Conclusion

For the evaluation of treatment course, infectious arthritis was induced experimentally in 4 healthy horses at the carpal joint by aseptically inoculating *Staphylococcus aureus* (1.6×10^6 colony forming units). The horses were divided into 2 groups in which one group (2 horses) was treated by injecting bee venom into the affected joint cavity, and the other group

(2 horses) was treated with the intramuscular injection of penicillin. The following results were obtained after evaluating the findings from clinical signs, total WBC, TP and AST activity in synovial fluid, synovial fluid bacterial culture, radiography, and thermography before bacteria inoculation, on 1 day bacterial inoculation and on 10, 20 and 30 days after treatment.

1. Bee venom and antibiotics were similarly effective for the treatment of experimentally induced arthritis.

2. Other than swelling, clinical signs gradually improved from 10 days of treatment.

3. Total number of WBC was decreased to the normal range on 20 days of treatment. TP in synovial fluid was gradually decreased from 10 days of treatment. AST activity in synovial fluid was decreased after 10 days of treatment and increased again after 20 days, decreased finally on 30 days of treatment.

4. Synovial fluid culture was positive for bacteria in 50% of the cases on 10 days of treatment and was negative in all horses on 20 and 30 days of treatment.

5. Other than soft tissue swelling, radiographic findings showed no changes in joint space and bone.

6. Thermographic findings showed that temperature difference between the right and left sides became smaller to the normal range on 30 days of treatment.

Thus, thermography would be an objective and effective tool for evaluation of horses with infectious arthritis along with clinical and laboratory tests.

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실험적으로 유발한 말 감염성 관절염의 치유경과에 대한 체열학적 평가

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요 약 : 말의 근골격계 질환의 진단과 치유 경과 평가를 위한 체열촬영술의 유용성을 검토코자 실험적으로 유발한 감염성 관절염의 치료 과정을 조사하였다. 실험적으로 완관절에 감염성 관절염을 유발하여 항생제와 봉독으로 처치한 후, 치료 과정별로 임상검사, 실험실 검사, 방사선 검사와 병행하여 실시한 체열촬영술은 전반적으로 모든 진단 결과와 유사하게 나타났으며, 진단 시 조직에 대한 비접촉성, 비침습성 및 무통성 특성과 함께 치유경과를 시각화, 객관화하므로 효과적인 것으로 판단되었다. 따라서 말의 근골격계 질환의 체열학적 평가는 기존의 검사나 진단 영상 장치와 더불어 말의 근골격계 질환의 진단 및 치유경과 평가에 있어서 유용할 것으로 사료된다.

주요어 : 체열학적 평가, 근골격계 질환, 말, 파행진단, 감염성 관절염, 치유경과