Pathogenicity and intraspecies transmission of severe fever with thrombocytopenia syndrome virus in dogs

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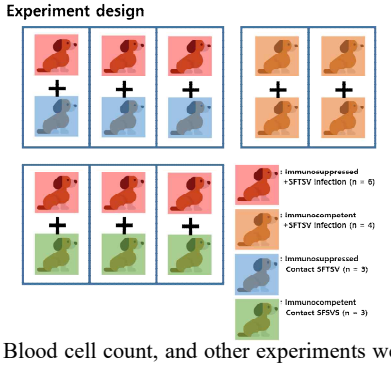
Abstract

Severe fever with thrombocytopenia syndrome (SFTS) is an emerging viral zoonotic disease. SFTS is caused by infection with *Dabie Bandavirus* [formerly SFTS virus (SFTSV)], transmitted through tick bites [1]. SFTSV has been detected by epidemiological surveys in various animal species, including companions [2]. Dogs are worldwide companion and can be infected with SFTSV, but pathogenicity and intraspecies transmission of SFTSV had remained unclear. To analysis such issues in dogs, we intramuscularly infected two groups of dog (1.6 x 10^8 $FAID_{50}$): immunosuppressed group (n = 6, oral azathioprine 5mg/kg/day for 30 days) and immunocompetent group (n = 4). Immunosuppressed contact dogs (n = 3) and immunocompetent contact dogs (n = 3) were co-housed with the SFTSV infected dogs with immunosuppression, respectively. All SFTSV infection studies were performed in an animal biosafety level 3 laboratory. Immunosuppressed SFTSV infected group showed high fever (over 40℃) from 1 to 5 dpi and decreasing body weight from 1 to 7 dpi. However, immunocompetent infected group did not show such clinical symptom. None of them was succumbed to SFTSV until 24 dpi. SFTS viral RNA was detected in serum at 3 dpi in all SFTSV infected dogs but viral RNA was not detected at 6 dpi and thereafter. Neutralizing antibodies in serum were detected in all SFTSV infected dogs from 9 dpi and gradually increased until 24 dpi. SFTSV viral RNA were detected in rectal swabs and urine in some of SFTSV infected dogs from 4 to 6 dpi. Immunocompetent SFTSV infected group showed thrombocytopenia from 3 dpi to the end of the experiment. Transmission of SFTSV was confirmed in one of three immunocompetent contact dogs co-housed with immunosuppressed SFTSV infected dogs. The transmitted dog showed high fever from 12 to 16 dpi. SFTS viral RNA and neutralization antibodies were detected in the serum at 15 dpi and 24 dpi, respectively. The transmitted dog shedded SFTS viral RNA in urine at 16 dpi

Methods

Experiment design



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Blood cell count, and other experiments were carried out to evaluate the severity of SFTSV. All SFTSV infection studies were performed in an animal biosafety level 3 laboratory. Experimental procedures and animal management procedures were undertaken in accordance with the requirements of the Animal Care and Ethics Committees of Jeonbuk National University.

Results

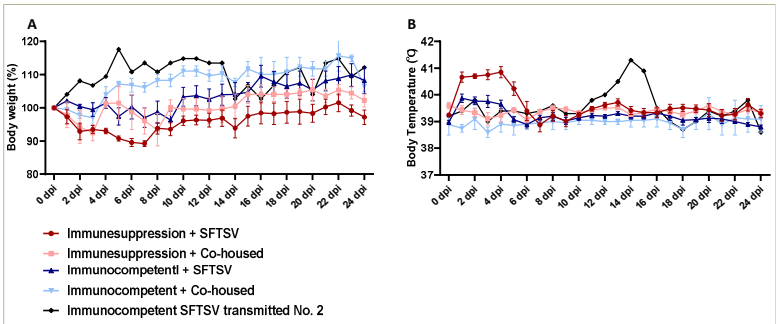

Figure 1. Weight loss and body temperature of canine with different immune competence after SFTSV challenge

We intramuscularly infected two groups of dog (1.6 x 10^8 $FAID_{50}$): immunosuppressed group (n = 6) and immunocompetent group (n = 4). Immunosuppressed contact dogs (n = 3) and immunocompetent contact dogs (n = 3) were co-housed in the cage which the SFTSV immunosuppressed infected dogs (n = 6) were housed in, respectively. Body weight (%) (A) , Body temperature (B, ℃) were measured. SFTSV was transmitted to one immunocompetent contact canine (immunocompetent SFTSV transmitted No.2)

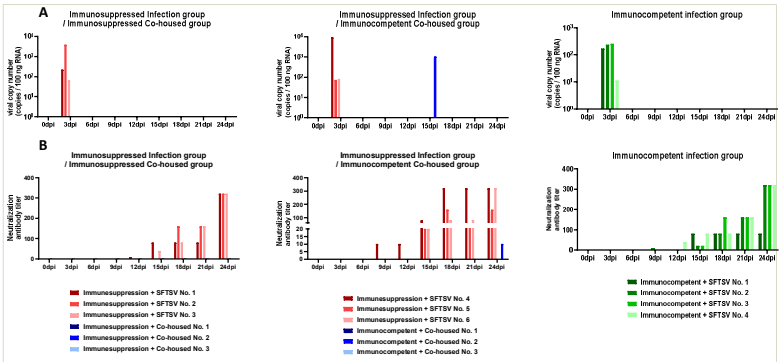

Figure 2. qPCR results of serum and neutralizing antibody titer

We intramuscularly infected two groups of dog (1.6 x 10^8 $FAID_{50}$): immunosuppressed group (n = 6) and immunocompetent group (n = 4). Immunosuppressed contact dogs (n = 3) and immunocompetent contact dogs (n = 3) were co-housed in the cage which the SFTSV immunosuppressed infected dogs (n = 6) were housed in, respectively. Serum samples were collected 0, 3, 6, 9, 12, 15, 15, 18, 21, and 24 dpi. Viral copy number (A) , neutralization antibody titer of the canine sera for SFTSV (B) were measured.

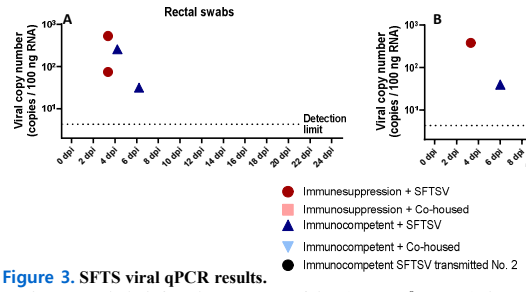

Figure 3. SFTS viral qPCR results.

We intramuscularly infected two groups of dog (1.6 x 10^8 $FAID_{50}$): immunosuppressed group (n = 6) and immunocompetent group (n = 4). Immunosuppressed contact dogs (n = 3) and immunocompetent contact dogs (n = 3) were co-housed in the cage which the SFTSV immunosuppressed infected dogs (n = 6) were housed in, respectively. Rectal swabs (A) , Urine (B) were collected 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 20, 22, and 24 dpi. SFTSV was transmitted to one immunocompetent contact canine (immunocompetent SFTSV transmitted No.2)

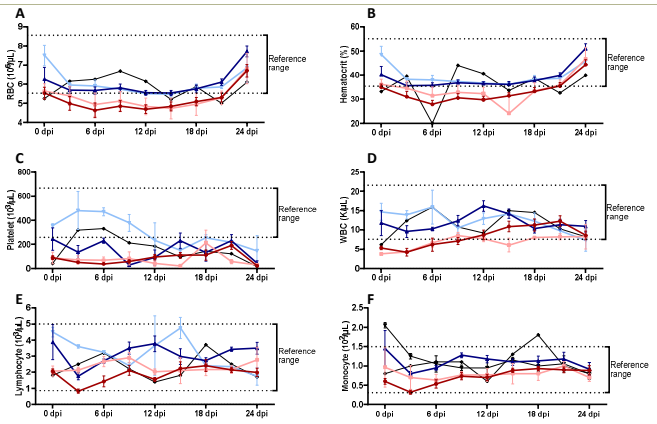

Figure 4. Blood cell count.

Complete blood cell counts were conducted using an automated blood cell counter. The RBCs (A), hematocrit (B), Platelet (C), WBC (D), Lymphocyte (E), and Monocyte (F) were analyzed. The values shown are the mean + SEM.

References

1. Chung JK, Kim CM, Kim DM, Yun NR, Park JW, Seo J, Kim YS: Severe Fever with Thrombocytopenia Syndrome Associated with Manual De-Ticking of Domestic Dogs. Vector borne and zoonotic diseases (Larchmont, NY) 2020, 20(4):285-294.

2. Kang J-G, Cho Y-K, Jo Y-S, Chae J-B, Joo Y-H, Park K-W, Chae J-S: Severe Fever with Thrombocytopenia Syndrome Virus in Dogs, South Korea. Emerging Infectious Disease journal 2019, 25(2):376.

Conclusion

These results showed that intramuscular infection with SFTSV induced minor clinical symptoms in dogs with immunosuppression and the intraspecies transmission of SFTSV in dogs could be occurred. Although immunosuppression did not affect the severity of viremia and transmissibility, further detailed pathogenicity and transmissibility study need to be performed in dogs.