Epidemiology Of Bordetella Bronchiseptica

PART A – Bordatella bronchiseptica Characteristics

Bordatella bronchiseptica species belongs to the genus Bordatella and the family Alcaligenaceae (Integrated Taxonomic Information System 2019). Bordatella species can only survive a few hours in respiratory secretions, however it can survive for up to 45 days in soil (Pathogen Safety Data Sheet 2010). Bordatella bronchiseptica can survive approximately 24 weeks in phosphate buffered saline and lake water at 10 degrees Celsius and 37 degrees Celsius without nutritional supplements (Material Safety Data Sheet 1999). This species can also survive in the environment, potentially due to its ability to adapt to changing environments by coordinating its gene regulation (Material Safety Data Sheet 1999). It can also survive in the environment because of the Bordatella virulence gene and regulation of its intracellular stress response (Coote, JG 2001, p. 81).

The most common host for this agent is dogs (Daniels et al. 2001). Kennel cough is an extremely contagious respiratory infection caused by Bordatella bronchiseptica and canine parainfluenza (Daniels et al. 2001). Other common hosts include humans, rodents, pigs, cats and non-human primates (Material Safety Data sheet 1999). Some less common hosts include mice, ferrets, turkeys, sheep, guinea pigs, horses and rabbits (Pathogen Safety Data Sheet 2010). According to Material Safety Data Sheet (1999), Bordatella bronchiseptica is zoonotic, meaning it can be transmitted from animals to humans. Bordatella bronchiseptica is shed in oropharyngeal and nasal secretions, for a maximum of 19 weeks post-infection (Scherk et al. 2013). The methods of transmission of this infection are direct contact with the infectious droplets and aerosols as well as with respiratory secretions and fomites (Pathogen Safety Data Sheet 2010). This includes contact with contaminated objects and direct contact with infected animals (PetAirapy 2019).

Incubation period is the time between when the host animal is infected and when they start showing clinical signs (Merriam Webster 2019). According to Gober et al. (2013), the incubation period for this infection is 3 to 10 days, with several weeks of pre-clinical shedding and sub-clinical infection. Gober et al (2013), also found that persistent infection recovered up to 14 weeks after clinical signs resolved. However, Thrusfield et al. (1991) suggests that the mean incubation period was 5 to 6 days and 2 to 14 days. Incubation periods can vary depending on the type of infection, the host and the individual animal. Latent period is the time between when the animal is exposed to the pathogen and infection (Field Epidemiology Manual n.d). This is hard to determine as pinpointing the time when the animal was exposed to the pathogen is very difficult. Latent infections can also occur after clinical signs have ceased (Buonavoglia et al. 2007). After both symptomatic and asymptomatic infections, dogs remain latently infected and the virus may be excreted at random intervals over several months or years (Buonavoglia et al. 2007, p. 358). Reactivation of the latent agent may be provoked by stress, such as relocation to new environments or the introduction of new dogs (Buonavoglia et al. 2007, p. 358).

Bordatella bronchiseptica typically lasts for 3 to 4 weeks in immunocompetent dogs, however if they are immunocompromised or are very young or old, it may last up to 6 weeks (PetAirapy 2019). However, according to Brooks, W (2001), dogs typically show signs of infection for 1 to 2

weeks, before shedding the Bordatella organism for 2 to 3 months following the infection. Similarly to the incubation period, the infective period varies due to the hosts individual immune response to the agent. Bordatella bronchiseptica is a gram-negative bacterium that causes respiratory diseases (Jeron et al. 2018). This pathogen interacts with the hosts immune system and affects a variety of immune cells. Macrophages have an important role in intracellular survival and cytotoxic affects for Bordatella bronchiseptica (Jeron et al. 2018). This agent is able to control cytokine production by macrophages through its secretion system, which in turn effects the T cell response. Bordatella bronchiseptica causes an influx of neutrophils, monocytes/macrophages and lymphocytes into the lungs (Jeron et al. 2018). The secretion system was also able to drive dendritic cell migration to secondary lymphoid tissue, along with an induction of anti-inflammatory interleukin-10 and down regulation of interferon-y response (Jeron et al. 2018).

PART B – Developing a Control and Prevention Strategy for Bordatella bronchiseptica

All this information can be compiled to make a control and prevention strategy. Knowing how long and where Bordatella bronchiseptica can survive outside the host can help us determine areas that susceptible animals should avoid. For example, this species can survive for up to 45 days in soil and is persistent in the environment (Material Safety Data Sheet 1999). Therefore if there was an outbreak of Bordatella bronchiseptica in a neighbourhood, residents could be informed to keep their dogs away from dog parks and digging in soil, there the pathogen could potentially be living. By identifying where and how long the pathogen can survive outside the host, we can control the source of the pathogen.

The host range is also important as this helps us determine whether the pathogen is zoonotic and if it is transmissible to other animals. Bordatella bronchiseptica. According to Material Safety Data Sheet (1999), Bordatella bronchiseptica is zoonotic and can also be passed on from animal to animal. Daniels et al. (2001) stated that dogs are the main host of this pathogen, therefore we know that as part of the control and prevention plan that outbreaks in dogs should be monitored more carefully, as they are more likely to become infected. The modes of transmission of the pathogen allow us to determine how to interrupt the transmission to stop or minimize the spread of the disease. According to the Pathogen Safety Data Sheet (2010), Bordatella bronchiseptica is transmitted by direct contact with the infectious droplets and aerosols, including direct contact with infected animals and objects. Therefore, a control and prevention strategy could include disinfecting all surfaces in a clinic or around the house that an infected animal has come into contact with to ensure other animals do not get infected.

Knowing the incubation period of the species is important, so that we can determine when the host animal first became infected, after showing clinical signs of the pathogen. Therefore we are able to implement a traceback approach to pinpoint the origin of the pathogen and where the animal became infected. According to Thrusfield et al. (1991), the incubation period for Bordatella bronchiseptica is 2 to 14 days, which seems to be the most common finding, however this period varies depending on the species and the individual animal. With this information, we can traceback the animals movements over the last 14 days before it showed clinical signs to determine where the animal became infected with the pathogen. From here, we are able to trace-forward to determine how many animals might become infected from visiting the area with high pathogenicity. The latent period is important in determining when the animal

became infected by the pathogen, as well as how long the infection remains in the animal after clinical signs have disappeared. According to Buonavoglia et al. (2007), dogs may remain latently infected with Bordatella bronchiseptica and the virus may be excreted over several months or years. This means that the animal can socialise with other dogs, however the pathogen may still be present in their excrement. This information is useful to traceback the animals movements to determine when it was infected, as well as afterwards in the shedding to determine how many animals may contract the infection.

How long the infection persists is one of the most important characteristics when developing a control and prevention strategy. According to Material Safety Data Sheet (1999) and Brooks, W (2001), Bordatella bronchiseptica can persist between 1 to 4 weeks in immunocompetent dogs, and longer in puppies or senior animals with a slightly compromised immune system. This is useful information, so vets are able to advise owners on when it is safe to socialise their dogs again without risk of infecting others. The immune response is important, as the animal will begin displaying clinical signs so the veterinarian can confirm the pathogen. Knowing when the animal is displaying clinical signs from the immune response to Bordatella bronchiseptica allows the incubation period to be known. This means that we can traceback the animals movements since becoming infected and then trace-forward to estimate how many animals may have become infected since.

Monitoring is also a useful way to detect the spread of disease, by assessing the geographic spread and prevalence of Bordatella bronchiseptica and monitoring trends over larger areas as well and new occurrences. This allows us to find particular regions that are the most effected and develop a prevention strategy based on the reason that incidence is so high. Surveillance is also useful after implementing control and prevention strategies to determine if these strategies are working and where more strategies need to be in place.

Based on all of this information, there are many control and prevention strategies that could be put in place. Vaccinations for example, prevent Bordatella bronchiseptica from infecting animals that have been vaccinated. This is done over 3 vaccinations to make sure that at least one of them has worked, depending on the maternal antibodies of the animal. Another is disinfecting areas such as kennels at shelters and isolation wards at clinics. This then interrupts the transmission between animals, therefore controlling the spread of this pathogen. Quarantine is also an option for animals entering the country. This is done to make sure that the animal in quarantine is not infected with Bordatella bronchiseptica, therefore controlling the spread of disease. Finally, public education is vital in the control and prevention strategy. If owners are aware of the symptoms of Bordatella bronchiseptica, they will be more inclined to take their animal to the vet, where they can be informed about incubation period and how long their animal should be kept in isolation.

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