Introduction

Canine Transmissible Venereal Tumor (CTVT) or “Sticklers Sarcoma” is a sarcoma cancer that is found within the domestic dog population. Although mainly affecting domestic canines, it can also affect others of the canidfamily such as wolves (vonHoldt and Ostrander 2006; Stockmann et al. 2011). Originally characterized more than 130 years ago, this cancer is parasitic acting as is jumps between canine via contact with the infected area that contains live cells (Murgia et al. 2006). This can include sniffing, mating, licking, or brushing against the affect area (Papazoglou et al. 2001). Normally, it would affect the genital and extragenital areas but can also be found within subcutaneous tissues such as the nasal cavity, oral cavity, and any other place that might come into contact with the live cancer cells (Stockmann et al. 2011). Something that is strange is that this type of cancer does not transfer to other species. In addition, there are only a few other known cancers that act like this; found in Tasmanian Devils and Syrian Hamsters (Ganguly et al. 2016).

Three lines of observation can been seen with this cancer; CTVT cannot be contracted unless via live cells, it has an aneuploid karyotype but has similar markers from different geographic regions, and lastly LINE-1 has been found in all CTVT tumors(Murgia et al. 2006). This LINE-1 element is not found naturally in a canine an dis upstream of the *c-myc* gene(Murgia et al. 2006; Rebbeck et al. 2009). Over time, this cancer has not originated many times, if any at all. It is thought this lineage has originally arose from a domestic dog or wolf due to the properties of the LINE-1 element (Rebbeck et al. 2009; Stockmann et al. 2011). In addition, if has been found that the *TP53* gene, which helps to suppress tumor, mutations have been seen in CTVT cases(Stockmann et al. 2011). The loss of the p53 protein has also been lost in canines with CTVT; whether through mutations, deletions, or pathways disruption is unknown(Murgia et al. 2006; Stockmann et al. 2011).

In addition, some canines can be at a higher risk of developing these canine tumors. Canines that are strays and unaltered females are highly at risk as well as canines that are left outside unsupervised (Ganguly et al. 2016). Unsupervised canines can have a high as a 96% prevalence rate due to them being able to roam or other dogs come into the area that they are occupying without owner interference (Ganguly et al. 2016). This is due to roaming animals being able to come in and out of those areas. So if a roaming stray is infected with CTVT, it may come into another canines population and spread it throughout due to migration of the stray. Development of CTVT within the canine population will increase in frequency in larger breed canines due to the tendencies of larger breeds to roam.

Methods

Data for positive CTVT canines was collected from published papers between the years of 2012-2019. These were then placed in an excel sheet which the breed of the animal was noted as well as any additional information that might be useful such as sex, age, and area where the case was reported. Canine breeds included in the data set were Cross Breeds, Spitz, Labrador Retrievers, German Shepard, Doberman, Great Dane, Yorkshire Terrier, and Dalmatian (Figure 1). Cross Breeds are considered anything canine that is not just one breed; this includes designer dogs like Golden Doodles but is mostly noted as stray dogs. To start, R coding software was used in order to graph the excel data. R-package “TidyVerse” was used to compare the canine breeds (Figure 1). It looks 162 total positive cases linked to the breed. These were plotted to see which breed had the largest number of reported cases. Secondly, a cladogram was created in order to visualize the relatedness of the canine breeds listed (Figure 2). This was created using various software packages within the R program. Data for the cladogram was read into R on all domestic canines. Figure 2 can be used in order to see how all of these breeds are related and if their relatedness could increase their susceptibility to CTVT. In addition, it may also show

Figure : Comparison of breed to amount the positive CTVT cases reported for the breed. These cases were collected from the years of 2012-2019 from published research articles.



Figure : Cladogram of different breeds of domestic canines. This cladogram is based on relatedness of each breed.

Results:

After data analysis, cross breed canines were found to be the most likely canines to be affected by the cancer (Figure 1). This could be related to the increased frequency that crossbreed canines are normally found freely roaming due to accidental pregnancies in female dogs. This can lead to increases in stray canines which are able to freely roam. Thus, they cross between different populations as they roam and have a higher likelihood of being infected. Spitz also showed a high frequency of reported cases. Spitz include a range of different breeds (Figure 1). These include Siberian Husky, Akita’s, and their relatives(2020). German Shephard, Doberman, and Labradors were also well represented in the analysis (Figure 1). These breeds with higher cases are all considered large-medium size dogs. All of these canines have a history of being a breed that roams, possibly making it more likely that these breeds will come into contact with the CTVT cancer. Thus, there breeds have shown a higher frequency in cases.

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