Tasmanian devil facial tumour disease

Fact Sheet

December 2023

Key points

- Tasmanian devil facial tumour disease (DFTD) is caused by a transmissible cancer.
- DFTD is transmitted between Tasmanian devils (TD) through direct contact during social interactions.
- Diseased animals present with tumours around the neck and face.
- This disease has resulted in significant TD population declines due to the extremely high mortality rate.
- Vaccination research is underway, however there is currently no effective treatment for individuals.
- DFTD is a nationally notifiable disease; you must notify animal health authorities if you suspect an animal has DFTD (see *Surveillance and management* below).

Aetiology

Tasmanian devil facial tumour disease (DFTD) is a neuroendocrine tumour, caused by clonal transmissible cancer cells [1]. Two types of cancer are known to cause DFTD; devil facial tumour 1 (DFT1) and DFT2.

One Health implications

Wildlife and the environment: it is estimated that in the areas of Tasmania where DFTD has circulated, the Tasmanian devil (*Sarcophilus harrisii*; TD) population has declined by greater than 70% [2]. DFTD remains a significant threatening process for the endangered TD [3].

Domestic animals: DFTD is not known to occur in domestic animals.

Humans: DFTD is not known to be zoonotic.

Natural hosts and world distribution

TD are the only known host for DFTD, which has only been detected in Tasmania.

Occurrences in Australia

DFTD only occurs in Tasmania. First detected in the north-east of the state, DFT1 is now found throughout Tas except for the north-west tip of the island. DFT2 is limited to the D'Entrecasteaux Peninsula [4-6].

Epidemiology

DFTD was first observed in 1996, and within three years caused a 30% decline in the TD population growth rate [7]. The disease is highly prevalent amongst the adult TD population, and is fatal in the vast majority of cases, although there have been small numbers of individuals who have recovered from the disease [5, 8, 9]. TD succumb to the disease due to secondary infection, metastases or starvation (due to the size and location of tumours) [10]. The latency period (the time taken from initial infection to clinical disease) is highly variable, with evidence suggesting it ranges from 2-13 months [2]. Most TD die within 3-6 months of showing signs but some affected individuals have survived for up to 18 months [11].

DFTD is transmitted between TD through the direct transfer of living cancer cells, most likely through biting inflicted during certain interactions such as feeding and mating [12]. Vertical transmission from mother to young has not been observed [2]. In one case where a young TD remained with the dam in captivity longer than would occur naturally, there was transmission from dam to young, but this likely via direct transmission such as biting [13]. DFTD follows a frequency-dependent transmission pattern, where it is unaffected by the density of TD populations [8].

DFTD mainly affects sexually mature individuals (between 2-4 years old), although most adults do not reach over 2 years due to the impact of the disease. It is thought that transmission is greater in adults as the prevalence of biting injuries in TD is at its highest during the mating season. As the age structure of TD populations has shifted, consisting now of mostly 1-2 year olds [5], 1 year old females are able to grow and gain enough body mass to facilitate breeding earlier, resulting in a rise in earlier sexual maturity than previously observed. This has not resulted in a change to the overall population decline [8, 14], however recent research into DFTD and TD genetics indicates potential host-pathogen co-evolution. At the time when both DFTD genetic diversity and TD population size was at its highest, the prevalence of DFTD infection was at its lowest in a TD population [15].

There has been extensive research around why DFTD cells are not rejected by the host's immune response [16]. It is believed that DFT1 cancer cells do not express major histocompatibility complex molecules, allowing the cancer to effectively avoid detection by the host's immune system. However, there is increasing evidence that some TD are able to mount an immune response to DFTD [17]. Signs of an immune response and associated recovery have been reported in a handful of animals infected with DFT1 [9, 18].

The second cancer lineage, DFT2, was first detected in 2014-2015. Although the two cancer lineages produce very similar clinical signs, DFT2 is histologically and genetically distinct from DFT1 [2]. Additionally, while no sex bias is observed in cases of DFT1 infection, in a small sample size, DFT2 appeared to infect more male TD than females. Co-infection with both DFT1 and DFT2 has been reported in TD [4].

Clinical signs and pathology

DFTD causes tumours which can vary in size and appearance. They are commonly found subcutaneously around the face, neck and mouth as firm, soft tissue masses. In most cases there is a clear margin between the mass and surrounding tissue [19]. Tumours appear initially as small lumps, progressing rapidly to become flattened, ulcerative masses that protrude from the skin [20].

These ulcerative and often exudative lesions can be variable in size but are often round and pink-red in colour, with the cut surface a cream colour. It is common for surrounding tissue to be inflamed and necrotic. Tumours can become locally invasive or metastasize. These metastatic masses are often solid, cream to tan-pink in colour, and have well-defined margins. It is common for DFTD tumours to spread throughout the body, and have been shown to metastasize in 65% of cases [19]. Other clinical signs may be present depending on the tumours location within the body [2].

Histologically, DFTD presents in the dermis, and is composed of compact round cells with indistinct cell borders, forming vascularised, dense masses contained within a pseudocapsule [19]. DFT1 and DFT2 exhibit similar gross pathological changes in TD, however DFT2 often causes necrosis of tissue resulting in a skin deficit [11]. There are differences between DFT1 and DFT2 in the cell types and cell arrangements that can be detected with histopathology [21].

Diagnosis

Initial DFTD diagnosis is commonly made by the appearance of clinical signs. Further testing using molecular techniques or histology is required to confirm a DFTD diagnosis and to differentiate between the two cancer types; DFT1 and DFT2 [21].

Immunohistochemistry can be used as a diagnostic tool for DFT1 due to a reliable DFT1 identifying marker. Due to different histological features, DFT2 does not express the same marker, making differentiation possible. Cytogenetics can be used to differentiate between the two cancer types, although this method is time-consuming and requires specialist skills. The Tasman-PCR is a rapid, highly specific and sensitive tool, able to differentiate between DFT1 and DFT2. Poor sample collection can reduce the sensitivity of this tool, and false positive results can occur [2, 21].

The detection of latent DFTD cases through preclinical diagnostics would allow for a greater degree of certainty when declaring DFTD freedom in a TD. Potential biological markers for DFTD with both high sensitivity and specificity include specific segments of fibrinogen, various metabolites, a specific growth factor [2] and an antimicrobial peptide [22] have been identified, however none have yet been found to be effective [2].

Clinical pathology

Changes in different white blood cells, platelet and erythrocytes counts, haemoglobin and fibrinogen concentrations, and other clinical biochemistry variables have been documented in affected TD compared with healthy individuals. However, these changes are consistent with inflammation and chronic disease and are therefore not specific to DFTD [23].

Differential diagnoses

Differential diagnoses in TD include other neoplasia (dasyurids appear more susceptible to neoplasia than most mammals), bacterial abscesses and lymphoproliferative disease.

Treatment

There is currently no effective treatment for DFTD. Trial studies of three different chemotherapy medications (vincristine, doxorubicin and carboplatin) found they were not successful in treating TD

with DFTD [24, 25]. Surgical resection has been successful in treating a very small number of experimentally infected animals where the masses were on the dorsum and so allowed greater margins than on the facial skin where natural infections usually occur [11].

An experimental trial was undertaken using tigilanol tiglate, a compound derived from the seeds of the blushwood tree (*Hylandia dockrillii*) found in Qld. It has exhibited some efficacy against DFTD after being injected directly into the tumours. While investigations into immunotherapy have shown potential to induce an immune response in TD to DFTD, more work is needed. Treatment of individuals is not an effective management strategy for the control of DFTD on a population scale [2], although it is important for the welfare of individual animals. As a result, there have been limited research efforts in this area.

Prevention, control and management

To effectively prevent and control the transmission of DFTD between individuals, healthy and diseased animals must be separated. The Tasmanian Department of Natural Resources and Environment established the Save the Tasmanian devil program (STDP), who developed a DFTD free captive insurance population [2]. The captive population is managed by the Australasian Zoo and Aquarium Association and in 2018 involved approximately 700 TD across Australia, Europe, New Zealand and America [5] Targeted breeding of TD within the population is aimed at preserving the genetic diversity of the species [26].

The insurance population has been used to establish wild disease-free populations of TD on Maria Island, and the Forestier peninsula, where existing TD were removed and barriers erected to create an isolated area free of diseased individuals. Research continues as to the best method for successfully reintroducing TD back onto mainland Tasmania [5].

Research and trials into an effective vaccine against DFTD are ongoing. A number of vaccination studies have been undertaken, producing variable results [27-31].

Due to lack of efficacious and practical treatment options, TD that are severely impacted by DFTD are euthanased for welfare reasons. Individuals in the early stages of the disease will continue to occupy ecological niches and contribute to reproduction, so are not culled. Culling of diseased TD in free-ranging populations as a management strategy occurred between 2004 to 2008 [2]. However the practice was ineffective in reducing population impacts or slowing disease progression [32, 33] and euthanasia is no longer used as a tool to manage population effects of DFTD.

Research

Key questions for investigation include:

- specific evidence for DFT2 transmission
- further research into the relationship between DFTD transmission and TD density and spatial ecology [34]
- investigation into the latency period of DFT1 and DFT2
- further investigation into the use of biological markers for preclinical diagnostics
- further development into rapid and inexpensive diagnostics [21]
- further investigation into an effective vaccine for DFTD [27-31]

- further investigation into an effective treatment for DFTD.

Surveillance and management

DFTD is a nationally notifiable disease (see www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/animal/notifiable). By law you must notify animal health authorities in your jurisdiction if you know or suspect that an animal has a notifiable pest or disease. Refer to advice in your jurisdiction (www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/animal/notifiable) and on outbreak.gov.au on how to report.

Repeated surveillance and monitoring of TD populations for DFTD, movement of DFTD to new areas and population estimates occurs through STDP. Multiple methods are used, including live trapping, camera trapping and spotlighting [35]. Recent research has highlighted the potential use of automated classification systems with camera trap images to differentiate between healthy and DFTD infected animals [36].

Wildlife Health Australia administers Australia's general wildlife health surveillance system, in partnership with government and non-government agencies. Wildlife health data is collected into a national database, the electronic Wildlife Health Information System (eWHIS). Information is reported by a variety of sources including government agencies, zoo based wildlife hospitals, sentinel veterinary clinics, universities, wildlife rehabilitators, and a range of other organisations and individuals. Targeted surveillance data is also collected by WHA. See the WHA website for more information https://wildlifehealthaustralia.com.au/ProgramsProjects/eWHIS-WildlifeHealthInformationSystem.aspx

We are interested in hearing from anyone with information on this condition in Australia, including laboratory reports, historical datasets or survey results that could be added to the National Wildlife Health Information System. Negative data are also valuable. If you can help, please contact us at admin@wildlifehealthaustralia.com.au.

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Wildlife Health Australia recognises the Traditional Custodians of Country throughout Australia. We respectfully acknowledge Aboriginal and Torres Strait Islander peoples' continuing connection to land, sea, wildlife and community. We pay our respects to them and their cultures, and to their Elders past and present.

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