Real-Time Detection of Covid-19 positive persons using sniffer dog

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Abstract

Sniffer dogs are able to detect chemical particles and help for diagnosis of non- infectious and infectious diseases, such as cancer, malaria or viral infections. With the global COVID-19 pandemics, there is an urgent need to have a real-time and rapid screening of infected individuals. A dog from the Marseille Fire Brigade was trained to detect SARS-CoV-2 positive individuals. Then, this dog was conducted in a facility for dependent elderly people in May and June 2021 to detect positive patients, who were simultaneously tested by the gold standard RT-PCR method. The detection ability of sniffer dogs was associated with 91.6% sensitivity and 97.8% specificity. Trained dogs are capable to identify COVID-19 cases and could so been used as a preliminary reliable tool for diagnosis at keys entry points, such as for example airports, seaports or districts in a city and hospitals.

Keywords: SARS-CoV-2, COVID-19, dog sniffer, diagnosis

1. Introduction

The current outbreak of the new severe acute respiratory syndrome (Covid-19) due to the severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) started in Wuhan, China, in late December 2019 and has spread to many other countries [1,2]. To date, more than 175 million cases and more than 3,5 million deaths have been reported around the world (WHO, [3]). This new coronavirus resembles the classical respiratory infection with common symptoms, including dry cough, fever, tiredness, myalgia and difficulty in breathing but also can cause gastrointestinal symptoms in 2- 10% of positive cases [4,5].

Like other RNA viruses, the gold standard for the detection and diagnosis of respiratory viruses usually require nasopharyngeal swabs and reverse transcription polymerase chain reaction test (RT-PCR), performed by a trained person [6]. RT-PCR testing has a high specificity and sensitivity, but it is time consuming and can be cost- prohibitive, particularly in developing countries. Moreover, it is practically impossible to test all the population or a subpopulation at the same time by using this method. Therefore, there is an urgent need for an additional, faster, reliable noninvasive screening tool to test a subpopulation, particularly asymptomatic or pre-symptomatic persons such as airports, seaports or during events bringing together a large number of people where we need to quickly test a very large number of individuals.

Dogs are known for their meticulous olfactory system and are commonly used in detecting explosive materials, drugs, dead bodies, as well as identifying cancer, bacterial and viral infections [7–12]. The use of sniffer dogs in medical field was related in 1989 by William and Pembroke that suggested that dogs are able to detect malignant tumors [13]. In the context of the Covid-19 pandemic, dog's ability to detect volatile organic compound signature (VOC) of SARS-CoV-2 infection offer a new universal testing strategy. To date, some studies have shown that dogs are able to detect SARS-CoV-2 signature from different biological fluids including urine, saliva/tracheal and sweat samples [14–18]. As dogs can be trained very quickly, in the present study, we evaluated the concept of using a trained dog in double blind real-time detection of SARS-CoV-2 infected and non-infected persons in 2 establishments for dependent elderly people. This method could be employed in the future to prevent spreading of SARS-CoV-2 or new outbreaks, by targeting critical areas such as airports, seaports, sport events, borders or mass gathering.

2. Results

The results for this study are shown in Table 1. The diagnostic sensitivity of the 3 dogs used in the study was 91.6% and the diagnostic specificity was 97.8%.

Table 1. Diagnostic performances of the dog

Establishment	SARS-CoV-2 Positive		SARS-CoV-2 Negative	
	True positive	False negative	False positive	True negative
1	0	0	2	88
2	11	1	3	45
TOTAL (n=150)	11	1	5	133
Sensitivity	0.916		NC*	
Specificity	NC*		0.978	

* not concerned

3. Discussion

Diagnostic approaches of Covid-19 can be divided into two main categories, clinical diagnostics and *in vitro* diagnostics [19,20]. Clinical diagnostics include symptoms and imaging, which may raise suspicion of COVID-19 but do not provide definitive evidence [21]. *In vitro* diagnostic tests for SARS-CoV-2 infection can be performed by using three different laboratory methods, (i) nucleic acid amplification tests detecting the presence of viral RNA by reverse transcription polymerase chain reaction (RT-PCR) or other amplification methods, (ii) tests detecting the presence of viral antigens, and (iii) tests detecting the presence of antibodies against SARS-CoV-2 antigens.

RT-PCR is currently the most common form of testing for the presence of SARS-CoV-2 in both symptomatic and asymptomatic patients [22]. RT-PCR to detect SARS-CoV-2 can be performed by targeting different viral genes, notably, the RNA- dependent RNA polymerase (RdRp), the viral nucleocapsid N gene and the envelope E gene [23,24]. The different viral targets and RT-PCR kits were associated with different specificity and sensitivity (from 76 to 100% and 100% respectively) depending on several comparison studies [25,26].

A rapid diagnostic can also be performed to detect the presence of viral antigens expressed by SARS-COV-2 virus in sample of infected individuals, by binding to antibodies affixed to a strip in a plastic casing. The reaction generates a visually detectable signal whitin half an hour. Another possibility is to perform an antibody test in response to infection, as IgM becomes detectable 2-3 days post infection, followed by IgG. This method is also very fast. However, antigens and antibody detection methods present lower sensitivity (28.9% to 99.1%) and specificity (92.4% to 100%) compared to the gold standard RT-PCR methods [27,28]. Obtaining RT-PCR results is time consuming and cost prohibitive, particularly for developing countries, and only a majority of symptomatic patients are tested. Therefore, there is an urgent need for a faster, reliable, noninvasive screening method to identify asymptomatic and presymptomatic individuals. Moreover, in some situation there is a need for massive testing in a limited period of time that cannot be assumed using *in vitro* tests, even rapid tests for diagnostic orientation.

Several studies have proven the canine olfactory system for medical purposes, like detection of non infectious diseases such as cancer [9], as well as infectious diseases like malaria [11], bacterial and viral infections [7,12] with high rates of sensivity and specificity. More recently, with the COVID-19 pandemics, the ability of dogs to detect positive cases was evaluated by several studies on human body secretions, like sweat, urine, nasopharyngeal, throat, trachea-bronchial and saliva samples [14–18]. Available evidences show promising results in terms of sensitivity and specificity. In this work, we evaluate the capacity of trained dogs to detect directly infected SARS-CoV-2 person and we

showed that the biodetections with dogs represent a highly sensitive and specific method (91.6% and 97.8% respectively). This approach provides a promising tool for COVID-19 mass screening at airports, seaports, train stations, stadiums, or in case of crowded events where it is essential to detect symptomatic but also asymptomatic individuals. We can imagine that sniffer dogs, after training with samples from infected people or even viral extracts [15] could help for the screening of potential SARS-CoV-2 infected individuals, followed by a rapid *in vitro* test like RT-PCR or antigenic tests. Biodetection dogs can also represent a robust diagnostic tool as each dog can screen approximately 250 people per hour [29].

4. Materials and Methods

4.1. Dog training and study design

The sniffer dog of BMPM was a 7 years-old female Dutch shepherd specialist in the search and rescue for buried persons. It is used to running following a trail and scent up to the victim. They search for a human and are trained by being rewarded when they find them. The dog was trained directly on Covid-19 positive persons. When the dog found a Covid-19 positive patient, the master gave her a treat or hugged her. The formation began on April 4th 2021 and lasted for 3 weeks.

4.2. Study population

The study was conducted with dogs into a facility for dependent elderly people in May and June 2021. The use of the dog for detection seized the opportunity of molecular monitoring tests by RT-PCR carried out on a weekly basis as part of the routine early detection of epidemics in elderly communities in high viral circulation phases. In parallel to the tests, the dog was used to detect positive and negative SARS-CoV-2 patients. The study was approved by the ethical committee of the University Hospital Institute Mediterranean Infection (2021-026). Results of RT-PCR and dog detections were anonymized before analysis.

4.3. RT-PCR for SARS-CoV-2 detection.

Dependent elderly people were tested by using Alinity m SARS-CoV-2 assay (Abbott, Rungis, France).

4.4. Analysis of sensitivity and specificity

Sensitivity (True Positive rate) measures the proportion of positives that are correctly identified. Specificity (True Negative rate) measures the proportion of negatives that are correctly identified. Specificity and sensitivity were calculated according to Trevethan [30].

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the ethical committee of the University Hospital Institute Mediterranean Infection (N°: 2021-026). This study was carried out in strict accordance with the recommendations in the Guide for the Care and Use of Animals edicted by French law (articles R214-87 to R214-137 of the rural code) updated by decree 2013–118 and 5 decrees edited on February 1st 2013. The protocol did not require to be approved by the Committee on the Ethics of Animal Experiments as no invasive study was performed on the dogs participating to the study, in accordance with the recommendations the inspector of Regional Directorate for Food, Agriculture and Forestry of Provence-Alpes-Côte d´Azur.

Informed Consent Statement: Informed consent was not needed as tests were done as part of the routine early detection of epidemics in elderly communities.

Conflicts of Interest: The authors declare no conflict of interest.

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