Olfactory Detection Dogs for COVID-19 Screening What's up to Date

Dominique Grandjean[1*], Clothilde Lecoq Julien[1], Capucine Gallet[1], Vinciane Roger[1] and Riad Sarkis[2]

[1] Department of Veterinary Sports Medicine and Rehabilitation, University of Paris-Est, Maisons-Alfort, France

[2] Department of Medicine, University of St Joseph, Beirout, Lebanon

***Corresponding author:** Dominique Grandjean, Department of Veterinary Sports Medicine and Rehabilitation, University of Paris-Est, Maisons-Alfort, France, E-mail:dominique.grandjean@vet-alfort.fr

Abstract

Olfactory detection dogs are an alternative method, for the COVID-19 testing and screening, in order to detect specific Volatile Organic Compounds generated by the SARS-CoV-2 infection. Several research teams are working on the subject and already demonstrated high levels of sensitivity and specificity of the "K9 COVID-19 test". The overall success will reported by the summarized studies is comparable to the standard RT-PCR results and higher than those with antigenic tests.

Therefore, even if further researches are already conducted, correctly trained and validated dogs could be deployed to non-intrusively screen and identify persons infected with a SARS-CoV-2 in mass testing or pre-testing in airports, senior care facilities, universities, public events, etc.

Keywords: COVID-19 ; Detection; Olfaction; Volatile organic compounds

Introduction

The COVID-19 worldwide pandemic has led to important research progress for both treating and vaccinating. However, the probably most important action to stop SARS-COV-2 virus spreading remains testing and rapid quarantine of positive individuals, as done for any epizoonotic-widespread screening with rapid results slows down and limits the progression of the infection.

Dogs are known for that extremely sensitive olfactory system that can even detect substances at a concentration as low as 1 part per trillion [1]. Humans have trained dogs for olfactory detection of explosives, illicit drugs and lots of other options including forensic purposes or search and rescue operations.

But recent researches show that there is an increased interest for the use of bio detection dogs in medical areas such as cancers identification or bacterial and parasitic infections, or alert diabetic/epileptic individuals of an upcoming crisis.

It appears that dogs can detect the Volatile Organic Compounds (VOCs) generated during such conditions, but in the case of microorganisms, the specificity of the induced odor still remains to discover.

Early 2020, we developed in Alfort School of Veterinary Medicine (France) the Nosaïs-COVID-19 program, in the science collaboration with St Joseph University of Beirout (Lebanon). We then were followed by other countries that adopted our basic protocol, based on axillary sweat samples, while other countries started working on urine, saliva or exhaled air.

Materials and Methods

COVID-19 detection dogs can be a plus in the fight against the pandemic. Studies are now done in dozens of countries; working connected one with each other in order to progress faster. Olfactory dog detection is a non-invasive, fast response, and cheap way to run mass testing. This article summarizes the international situation regarding these detection dogs.

Eight detection puppies had been educated for 1 week to stumble on saliva or tracheobronchial secretions of SARS-CoV-2 inflamed sufferers in a randomized, double-blinded and managed study.

There has been very few, remoted and criticizable reviews at the passive carriage of SARS-CoV-2 virus through the canine, with very small quantities of viral RNA, indicating that the samples, accrued through an inflamed person, had a completely low viral load. The low viral titres determined on this dog recommend it had evolved a low-efficient contamination, and the probability of infectious transmission became minimum or none existent.

A 2nd case became alerted in Hong-Kong whilst the proprietor examined nice for COVID-19 contamination stayed in quarantine together along with his puppies. One of them became examined nice for quantitative PCR however by no means had any symptom, the alternative stayed negative. As with the primary canine, the contamination became very low nice and non-contagious.

In the USA, Idexx Laboratories examined extra than 4000 dog specimens at some point of its validation of a brand new veterinary take a look at device for the SARS-CoV-2 virus and

observed no nice animal. More currently a primary examine carried out in Alfort School of Veterinary Medicine (France) confirmed the absence of SARS-CoV-2 contamination in puppies in near touch of a cluster of COVID-19 patients.

Finally, the CDC (Center for Disease Control and Prevention) with inside the USA and the ANSES (National Agency for Food, Environmental and Occupational Health Safety) in France at take a look at that there's in reality no proof that puppy animals, and specially puppies, play any massive function withinside the transmission or in spreading the virus that reasons COVID-19, and the danger is taken into consideration as near zero.

Researches: what is known

Several studies, recently conducted in different countries, in order to evaluate if a specific odor is related to COVID-19 in humans, converge to confirm the capacity of dogs to detect it in various body fluids, with high levels of sensitivity and specificity.

We published a proof of concept based on axillary sweat samples of 198 COVID-19 positive and negative individuals, with an accuracy of the dogs ranging from 83 to 94 p100 [2]. Jendrny published a pilot study showing that the dogs were able to discriminate between samples of infected and non-infected individuals with average diagnostic sensitivity of 82.6p100 and specificity of 96.3p100, based on saliva or tracheobronchial secretion of patients [3].

The same authors, more recently, assessed that the scent cognitive transfer performance between different sample materials (saliva, urine, sweat) indicates that global, specific SARS-Cov-2 associated Volatile Organic Compounds(VSC) are released across different body secretions, independently from the patient's symptoms [4].

Essler also published a proof of concept where dogs successfully discriminated between infected and uninfected urine samples, while Vesga trained dogs on respiratory secretions of infected patients, achieving average sensitivity of 88.8p100 and specificity of 97.4p100 [5,6].

Finally, in a long-term collaboration with the dog teams deployed in the United Arabian Emirates, we could evaluate the sensitivity of 21 trained dogs with results higher than 90p100 for 15 of them, and ranging from 80 to 87p100 for the remaining 6 dogs [7]. **Table 1**, published by the world Health Organization, summarizes the results obtained at date around the world [8].

Country	Success rate	Sensitivity	Specificity	Ref.
France	90.50%	-	-	Grandjean and coll, PLOSOne, 2020
Sweat	76-100*			
France		89.80%	90.20%	Preprint
Sweat				
France		88%	85.20%	Preprint
Sweat				

Country	Success rate	Sensitivity	Specificity	Ref.
Germany	94%	82.60%	96.35%	Jendrny and coll,
Inactivated saliva and/or tracheobronchial secretion		(82.02–83.24)	(96.31-96.39)	BMC Inf. Dis., 2020
Inactivated saliva		84%	95%	Jendrny and coll, 2021
		(62.5–94.44)	(93.4–96)	
Non inactivated Saliva		82%	96%	
		(64.29– 95.24)	(94.95–98.9)	
Sweat		91%	94%	
		(71.43–100)	(90.91–97.78)	
Urine		95%	98%	
		(66.67–100)	(94.87–100)	
Iran		65.40%	88.90%	Eskandari and coll,
Nasopharyngeal				BMC Inf. Dis., 2021
Masks and clothes		86%	92.90%	
Colombia				
Saliva and/or respiratory secretions		88.80%	97.40%	Vesga, Preprint
Brazil	97.40%			Preprint
UAE		91.50%	96.30%	Grandjean, Preprint
Argentine		93%	88.80%	Preprint
Australia		99.60%	94.50%	Conference
Lebanon		99.80%	92%	Sarkis, Preprint
Sweat				
Lebanon		96%	90%	Conference
Sweat-airport				
Chile		89.50%	97.20%	Conference
Sweat		(83.8-93.4)	(95-98.5)	
Finland		100%	90.70%	Conference
Sweat urine, saliva				
Belgium	95%	81%	98%	Conference
Sweat				
*Interval of success; Between brackets: 95% confidence interval				

Table 1: COVID-19 detection dogs: Actual results found in the literature and conferences.

Researches/what's next

Beside proving concepts or determinations by double-blind validations the individual values of dogs' sensitivities and specificities, other research programs are ongoing and now more or less coordinated thanks to the action of WHO and to bimonthly symposiums organized by UAE Ministry of the Interior.

They concern:

- The chemical determination of the Volatile Organic Compounds involved
- The effects of the different variants on the dogs' marking
- The eventual interactions induced by vaccination (especially when mRNA vaccines)
- The standardization of the training/validation process
- The technical means that would facilitate rapid deployments of dogs.

Results

In verification take a look at the usage of pharyngeal secretion, the sniffer dogs' detection functionality turned into related to a sixty five% of sensitivity and 89% of specificity and that they controlled to perceive 17 out of the 26 effective and forty eight out of the fifty four real terrible samples. In the following verification take a look at the usage of patients' face mask and clothes, forty three out of the 50 effective samples had been effectively diagnosed through the dogs.

Moreover, out of the 70 terrible samples, sixty five samples had been effectively observed to be terrible. The sensitivity of this take a look at turned into as excessive as 86% and its specificity turned into 92.9%. In addition, the effective and terrible predictive values had been 89.6 and 90.3%, respectively.

These initial findings imply that skilled detection puppies can discover breathing secretion samples from hospitalised and clinically diseased SARS-CoV-2 inflamed people through discriminating among samples from SARS-CoV-2 inflamed sufferers and bad controls.

Discussion

This statistics can also additionally shape the premise for the dependable screening technique of SARS-CoV-2 inflamed people.

With our Nosais team we just finished a field study of a large cohort of individuals showing up in detections centers and tested by both nasopharyngeal and saliva RT-PCR.

Conducted by APHP (Assistance Public Hospitals De Paris) providing us anonymous sweat samples without any information on their positiveness or negativeness, the results, not published yet, show a global sensitivity of 97p100 with a specificity of 91p100 for the dog olfaction test, and these values raise 100p100 and 94p100 for asymptomatic individuals! It seems also that dogs have no problem with English, Brazilian and South African variants.

Bio detection dogs can definitely represent a robust diagnostic tool, when correctly trained and validated, in the fight against COVID-19.

Conclusion

They are efficient, non-invasive, and way cheaper than any other test. Such dogs have already been deployed in airports (Finland, Lebanon, UAE, Chile, Italy, Russia), at road borders (UAE), for clusters (France), in nursing-houses or for sport-events (USA), and the UAE has set up mobile units involving specially equipped trucks.

Acknowledgement

The economic benefits from such a screening would be great. Fast results, and the sensitivity, specificity and overall success rates reported by all early COVID-19 scent dog detection studies appear to be at least equivalent to the standard RT-PCR and better than the antigen testing methods.

Conflict of Interest

There are no conflicts of interest to declare with regard to this paper.

References

1. Jones R T, Guest C, Lindsay S W, Kleinschmidt I, Bradley J, et.al (2020) Could bio-detection dogs be used to limit the spread of COVID-19 by travellers ? J Travel Med 27:1-3

2. Grandjean D, Sarkis R, Julien C L, Benard A, Roger V, et.al (2020) Can the detection dog alert on COVID-19 positive persons by sniffing axillary sweat samples? A proof-of-concept study. plos.org 12:e0243122

3. Jendrny P, Schulz C, Twele F, Meller S, Blickwede K M V, et.al (2020) Scent dog identification of samples from COVID-19 patients -a pilot study. BMC Infect Dis 20:536

4. Jendrny P, Twele F, Meller S, Schulz C, Blickwede K M V, et.al (2021) Scent dog identification of SARS-CoV-2 infections, similar across different body fluids. bioRxiv.org

5. Essler J L, Kane S A, Nolan P, Akaho E H, Berna A Z, et.al (2021) Discrimination of SARS-CoV-2 infected patient samples by detection dogs: a proof of concept study. plos.org 16:e0250158

6. Vesga O, Valencia A F, Mira A, Ossa F, Ocampo E, et.al (2021) Dog savior: immediate scent-detection of SARS-CoV-2 by trained dogs. bioRxiv.org

7. Grandjean D, Marzooqi D H AL, Julien C L, Muzzin Q, Hammadi H K AL, et.al (2021) Use of canine olfactory detection for COVID-19 testing study on UAE trained detection dog sensitivity. J Vet Sci res 6:000210

8. World Health Organization (2021) Consultation on the use of trained dogs for screening COVID-19 cases.