

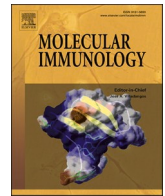


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Editorial

Research in non-rodent vertebrates enlightens the immunological landscape

With the CoronaVirus Disease 19's (COVID-19) crisis, this last year has been extremely rich for immunology and infectious diseases, and these scientific disciplines are getting better known by general public through an impressive number of articles in media and specialized literature. As a result, an increasing proportion of lay people are becoming familiar with terms such as antibodies, variants, RNA and immune defenses and it will continue for months and even more. The emergence of Severe Acute Respiratory Syndrome CoronaVirus 2 (SARS-CoV-2) from a natural bat reservoir with the possible involvement of a still unidentified intermediate host strongly reminds us the interconnection between humans, animals, plants and the environment. Since more than 75 % of the viruses affecting humans have an animal origin (Jones et al., 2008; Taylor et al., 2001), an integrated approach of health such as the One Health approach is clearly needed (Kelly et al., 2017).

In immunology, most of our knowledge is coming from the mouse model which enabled major progresses in human immunology. However, mice are not small humans, even humanized ones, and immunology is still a young scientific discipline with many more discoveries to expect in the next years. Amongst animal models, the porcine model attracted a lot of attention recently because of the anatomic and genetics proximity of pigs and humans and more tools are getting available to dissect immune responses in the pig species. However, comparative immunology still needs a lot of efforts to progress in existing models and to bring new animal models at their full potential. A good example of the need for research in the field of animal models immunology has been provided with the current COVID-19 crisis. Indeed, amongst the best models to study COVID-19, the ferret (*Mustela putorius furo*) and the Syrian hamster (*Mesocricetus auratus*) have been identified (Khamisse et al., 2020; Monchatre-Leroy et al., 2021; Muñoz-Fontela et al., 2020). The knowledge of the immune system of these two species is still scarce and there is a dramatic lack of reagents and tools, complicating and limiting their use in the fight against SARS-CoV-2. Besides, the vast majority of animals are still poorly known in terms of immunology and host/pathogen(s) interactions. However, this special issue illustrates that, thanks to the constant accumulation of basic tools such as specific antibodies as well as the increasing number of sequenced genomes associated with RNAseq development, the knowledge of exotic species' immune system is reaching a point that allows their harnessing for biomedical research.

In 2020 and 2021, world travels have been extremely reduced and it will take years to come back to the pre-COVID-19 situation. In the current special issue, we offer the readers the possibility to re-travel quickly in our fascinating world from Australia to China and Europe as well as America six years after a first trip (Montoya and Meurens, 2015). Moreover, we are also travelling in molecular and applied

immunology throughout the warm blood vertebrates' evolutionary tree, from the chicken (*Gallus gallus domesticus*) to several placental mammals, the alpaca (*Vicugna pacos*) and others camelids, the large mammals, such as porcine (*Sus scrofa*), bovine (*Bos Taurus*) and equine (*Equus caballus*) and the primates, macaque (*Macaca sp.*) and baboon (*Papio sp.*). In the birds, we focus on the chicken with Clive A. Tregaskes and Jim Kaufman who present us the MHC of these animals which is simpler than its counterpart in mammals offering an interesting model of research. After we move to large animals such as *Camelidae* which are unique amongst mammals for their very special IgG are the subject of interest. Darryl Falzarno and Swarali Kulkarni are presenting us the unique aspects of their adaptive immune system. Then, we will explore the large mammals with Cynthia L Baldwin and colleagues who invite us to discover the $\gamma\delta$ T cells in these animals. Among large mammals, one of our faithful domestic companion is the horse, Elisabeth M Larson and Bettina Wagner highlight the important similarities in the immune landscape between horses and humans using current research on two equine diseases as examples. Three articles bring up the pig model. One, from Tobias Käser summarizing the interest of swine for biomedical research with a focus on T cells. A second, focusing on the porcine respiratory tract as a biomedical model for the study of acquired human pathologies (see the review from Nicolas Bertho and François Meurens). And finally, a primary research paper on porcine TLR8 which has been the subject of many studies in the pig (Ao et al., 2019; Cervantes et al., 2012; Ugolini et al., 2018; Zhu et al., 2008) since in that species like in human, but unlike in mouse, TLR8 is responding to single-stranded RNA (Ugolini et al., 2018).

Then we finish our trip with our relatives, the non-human primates. Pauline Maisonnasse and her colleagues are showing the interest of macaque and baboon in the fight against human infections, a hot topic in the context of COVID-19 crisis.

With the current special issue, we hope that we can stimulate and develop the interest of the scientific community for immunological research in non-rodent vertebrates. One of the best, if not the best, protection against all the assaults animals are facing during their life is their immune system. Comparative immunology is still in its infancy and the next decades will be undoubtedly rich in this fascinating discipline.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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