Using Drones For Organ Transportation: INDOOR project

Federico Genzano Besso[1], Morteza Mansouri[1], Mattia Brunelli[1], Antonio Amoroso[1], Chiara Bosso[1,2], Giorgio Guglieri[2], Marcello Chiaberge[2], Giuseppe Quaglia[2].

[1] Department of Medical Sciences, University of Torino and Immunogenetics and Transplant Biology Service, University Hospital "Città della Salute e della Scienza di Torino" and Regional Transplant Centre of Piemonte, Turin, Italy.

[2] Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Turin, Italy.

Background

Nowadays, the recurring need to simplify and speed up the transport operations of biological material matches the demand for the reduction of its transport time between two geographic points that are not too far from each other. Moreover, the promotion of innovation and automation of critical clinical processes, and the development of a very high technology device can be considered as competitive tasks. It must be considered that the transport conditions (mechanical stresses, temperature) can influence the outcome of clinical operations. Today's technology provides tested, controlled and safe devices – the drones – for multiple applications, which can be extended to the medical field, too.

Methods

Two maximum parameters of two types of drones – a multi-rotor (MR) and a fixed-wing (FW) drone – were considered: the cruising speed (MR: 60 km/h, FW 100 km/h) and battery autonomy (MR: 45 mins, FW: 2 hours). However, generally fixed-wing drones can lift higher loads than the others. By Italian Civil Aviation Authority (ENAC) regulations a drone flight requires authorizations and the drafting of an appropriated Risk Assessment. Therefore, two parallel studies were carried out: the first one aimed to design the box for biological material (biological samples and kidneys – the other organs require the presence of the surgical transplant team, so they can't be transported by drone), to detect and process vibrations signals aboard the drone and to their replication by a test machine – shaker –, by stressing biological samples and studying their biochemical response. The second one, aimed to the flight of a drone within an urban environment in the absence of biological material on board. The purpose of the project is the integration of these two branches to validate the flight of biological material, first in Visual Line of Sight (VLOS) and then in Beyond Visual Line Of Sight (BVLOS) conditions.

Results

The biological samples were stressed in a selected frequency range (0–150 Hz) and the appropriate documentation was drawn up. The risk analysis made it possible to identify the security level, acceptable to ENAC to confirm its interest in the operation.

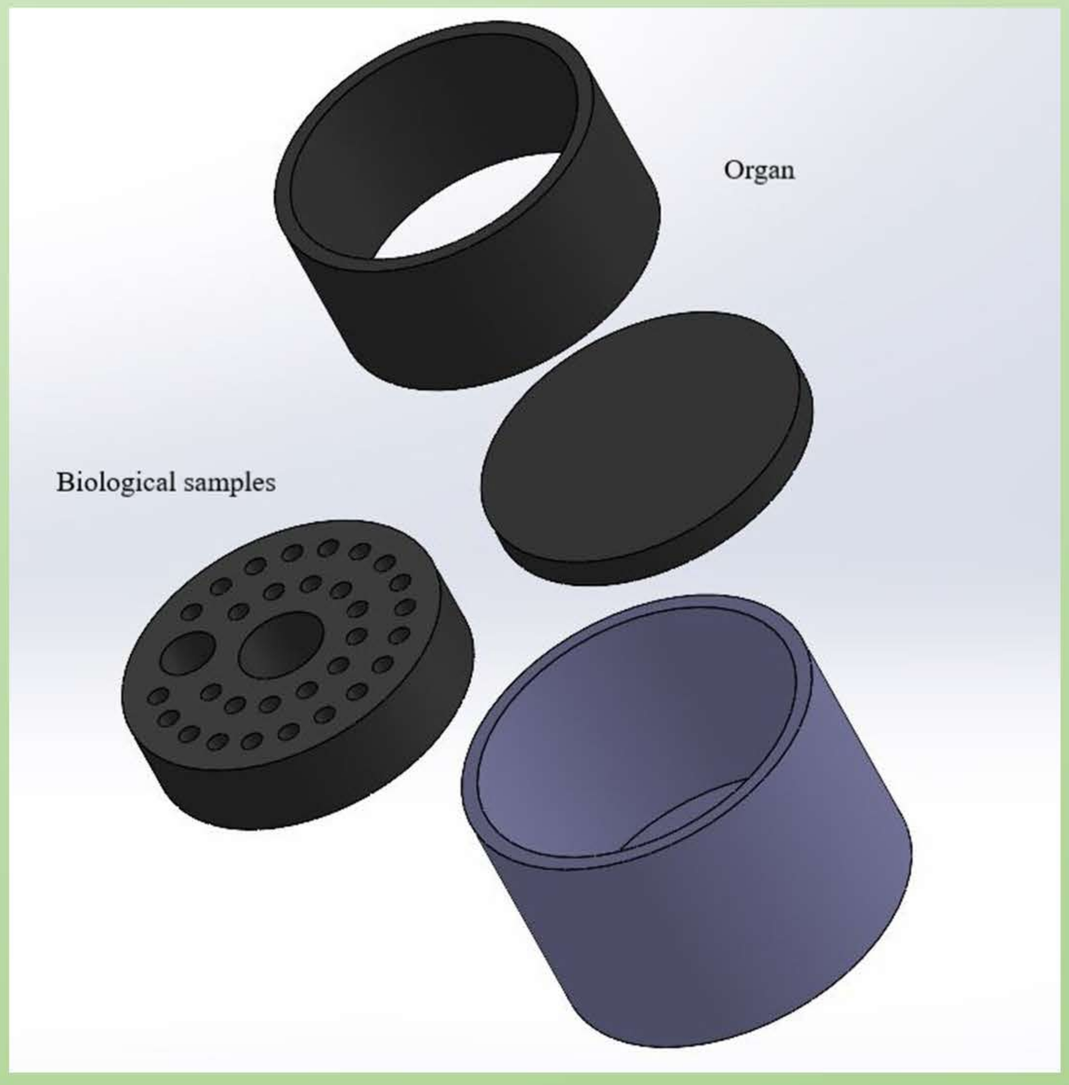

Figure 1 *The figure shows the configuration of the primary container and of the foam rubber (shock-absorbing) platforms*

Conclusions

The technology of a drone is almost consolidated: this study is going to prove the feasibility of integrating smartly aeronautical specifications to the transplant clinical needs.