

Using Machine Learning to develop a predictive risk algorithm of postoperative neurocognitive disorders

Context: Nearly 313 million major surgical procedures are performed every year in the world, and 25-30% of them involve patients aged 60 years or older ¹. This rate is expected to quadruple over the next 30 years due to aging - predicted to reach 2.1 billion people by 2050 -, especially in orthopedic and cardiac surgeries ². One of the most frequent postoperative complications is postoperative neurocognitive disorders (POND), which include disorders of memory, language comprehension, visuo-spatial abstraction, attention or concentration, and whose symptomatology may last up to 12 months after surgery ³. These POND are observed in 25-55% of patients undergoing major surgery and are associated with increased morbidity and mortality ⁴. In addition, they represent a significant economic cost due to more frequent hospitalizations in care facilities, earlier retirement, and greater use of socioeconomic support ⁵. Preoperative identification of patients at risk for POND should allow the development of personalized prevention programs aiming at reducing the incidence of these complications, as no curative treatment currently exists.

Objective: The internship is aimed at developing and validating a predictive risk algorithm of POND, based on preoperative data, using machine learning techniques.

Material: Development of the algorithm and its validation will benefit from datasets on a total of 301 patients that have already been collected in 14 French university hospitals between 2016 and 2019. Patients clinical and cognitive status in the preoperative period, and in the 90 first postoperative days were assessed during this prospective, interventional, multicenter clinical trial (NCT02892916).

Method: The complex nature of the POND arises from non-linear interactions among a web of preoperative determinants. Therefore, the development and the validation of a predictive risk algorithm of POND involve the use of elaborated statistical models. In addition, the future algorithm is expected to be integrated in medical decision support systems for clinical practice, and thus has to show a good generalization ability (*i.e.* ability to successfully account for previously unseen data). To this end, a rigorous methodology of machine learning (for the selection of features, the estimation of the generalization error, etc.) and statistical models from the field of machine learning (including, but not restricted to, neural networks) will be used.

Supervision: The intern will benefit from a co-supervision by two experts (MD, PhD), one from the field of perioperative medicine and principal investigator of the clinical trial (Franck VERDONK), and the other from the fields of cognitive neuroscience and machine learning (Charles VERDONK).

Aims of the internship

1. Pre-processing of datasets that have already been collected, including aggregation and structuration of data.
2. Development and validation of a predictive risk algorithm of POND using state-of-art machine learning techniques.
3. Dissemination of the project results to medical and scientific audiences, including active contribution to the writing of one or more publications in international journals.

Profile

We are looking for a talented, creative and highly motivated Master 2 student from the field of machine learning, who has developed strong programming skills in the Matlab language that will be used for data analysis, and good knowledges on statistical models from the field of machine learning (including neural networks). Basic knowledge on perioperative medicine and cognitive neuroscience will be considered as valuable in the recruitment process.

Practical aspects

- Duration: 6 months
- Starting date: according to the curriculum of the Master
- Gratification: according to legal standards
- Internship place: Hôpital Saint Antoine - GRC DREAM - Assistance Publique Hôpitaux de Paris and/or remotely

Application process

Please send your CV (up to 2 pages) via email to the two supervisors (see contact details below)

Supervision

Franck VERDONK (fverdonk@stanford.edu ; +33677783877), MD, PhD

Associate Professor - Sorbonne Université - Paris

Deputy Head of Anesthesiology and Intensive Care Department - Hôpital Saint Antoine/Tenon - APHP - Paris

Visiting Professor - Stanford University - California

Charles VERDONK (verdonk.charles@gmail.com), MD, PhD

Neuroscientist - French Armed Forces Biomedical Research Institute (IRBA)

Department of Neurosciences and cognitive sciences - Unit of Neurophysiology of stress - Brétigny-sur-Orge

[Website of IRBA](#)

References

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