Guest Editorial

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If Oscar the cat could, can't we? – A commentary on intraoperative hypotension – Role of artificial intelligence

'Oscar jumps onto her bed and sniffs the air. He pauses to consider the situation, and then turns around twice before curling up beside Mrs. K. Thirty minutes later, Mrs. K. takes her last earthly breath.' Since he was adopted by staff members as a kitten, Oscar the cat has had an uncanny ability to predict the death of the residents of Steere House Nursing and Rehabilitation Center in Providence, Rhode Island, USA.[1] If a cat could predict death, can't we predict clinical events – with the help of artificial intelligence (AI)?

Intraoperative hypotension is not infrequent during anaesthesia. The aetiology may be one or combination of the following: induction of general anaesthesia itself, use of vasodilator techniques, sympathetic block (as in central neuraxial blocks), myocardial depression, fluid loss, or perioperative haemorrhage. Hypotension may produce organ dysfunctions that manifest in the postoperative period; the degree of dysfunction depends on the duration and intensity of hypotension.[2] Considering this, it may be worthwhile if one could predict and prevent episode/s of hypotension. The event of hypotension is preceded by a set of logically predictable minute physiological events, which at times are subtle that an ordinary human mind may fail to take note. Machine learning algorithms have been pressed into detecting such changes (that may ultimately culminate in intraoperative hypotension). Machine learning, a discipline within computer science which is used to analyse large data sets and develop predictive models, has evident applications to other branches of health care too. A few risk factors contributing to post induction hypotension have been described (old age, emergency surgery, pre-induction hypotension). Similarly, hypotension later in the surgery is said to be associated with male sex, supplementary neuraxial anaesthesia or increasing American Society of Anesthesiologists' grading. Physiologically, hypotension occurs due to decrease of either preload or afterload or cardiac output. Observing the changes in the conventionally monitored parameters such as central venous pressure or mean arterial pressure may be too late to prevent occurrence of hypotension. The ability to prevent intraoperative hypotension would exponentially decrease the occurrence of complications.[3] The sympatho-vagal balance has been utilised as a predictor of hypotension among women who received spinal anaesthesia while undergoing Caesarian section and found significant contribution of R-R interval variability. This is one method of applying AI in predicting hypotension.[4]

Recently, Hatib and co-workers[5] commented that the key steps in development of the algorithm for preventing hypotension are summarised as follows:

1. Data conditioning, including signal pre-processing, heartbeat detection and data selection;
2. Featurisation of the arterial pressure waveform (extraction of key features or signatures);
3. Annotation of the training data set for periods of hypotension and non-hypotension;
4. Model training.

AI devices mainly fall into two major categories. The first category includes machine learning techniques that analyse structured data such as imaging, genetic and electrophysiological data. In the medical applications, the machine learning procedures attempt to cluster patients' traits, or infer the probability of the disease outcomes.[6] The second category includes natural language processing methods that extract information from unstructured data such as clinical notes/medical journals to supplement and enrich structured medical data. Many workers have put AI to use in the areas of

cancer, cardiology and neurology.[7] 'The hypotension prediction index', is one such commercially available algorithm, which reliably predicts hypotension up to fifteen minutes prior to its occurrence; it has the potential to change our practice from reactive to proactive blood pressure management.[5]

With new innovations come hitherto unknown medico-legal issues. The legal circles are now discussing who will own up computer generated erroneous decisions causing patient harm?.[8] The task force that was set up to assess this matter, implied that the AI system would be liable for any medical negligence claim, this certainly would complicate the vendor client engagement laws!

Using AI in medical interpretation and treatment is just the beginning. In future AI in haemodynamic predictions in particular and medical therapeutics in general is likely to impact the way we practice medicine enormously. Though AI appears to be hugely supportive at the outset, there are still issues in real life implementation. AI as a 'product' has not been defined in many countries, federal drug administration has classified AI as 'general wellness product'.[9] Clinicians must remain alert and overrule the computer-generated warning, should it be obviously erroneous. Continuous data exchange is necessary and will make the AI system robust. A big data revolution is about to happen and clinicians have to be aware to realise its arrival. Who knows? Many 'Oscars' may be around the corner to assist healthcare professionals!

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