Artificial Intelligence in Anesthesiology: Current Techniques, Clinical Applications, and Limitations

Abstract (600 words):

Artificial intelligence has been advancing in fields including anesthesiology. This scoping review of the intersection of artificial intelligence and anesthesia research identified and summarized six themes of applications of artificial intelligence in anesthesiology: depth of anesthesia monitoring, control of anesthesia, event and risk prediction, ultrasound guidance, pain management, and operating room logistics. Based on papers identified in the review, several topics within artificial intelligence were described and summarized: machine learning (including supervised, unsupervised, and reinforcement learning), techniques in artificial intelligence (*e.g.*, classical machine learning, neural networks and deep learning, Bayesian methods), and major applied fields in artificial intelligence. The implications of artificial intelligence for the practicing anesthesiologist are discussed as are its limitations and the role of clinicians in further developing artificial intelligence for use in clinical care. Artificial intelligence has the potential to impact the practice of anesthesiology in aspects ranging from perioperative support to critical care delivery to outpatient pain management. Anesthesiology as a field is well positioned to potentially benefit from advances in artificial intelligence as it touches on multiple elements of clinical care, including perioperative and intensive care, pain management, and drug delivery and discovery. We conducted a scoping review of the literature at the intersection of artificial intelligence and anesthesia with the goal of identifying techniques from the field of artificial intelligence that are being used.

Importance of Research(200 words):

Although different taxonomies of artificial intelligence have been previously described, common to many of these is the categorization of machine learning as one of the major subfields of artificial intelligence. Traditional computer programs are programmed with explicit instructions to elicit certain behaviors from a machine based on specific inputs (e.g., the primary function of a word processing program is to display the text input by the user). Machine learning, on the other hand, allows for programs to learn from and react to data without explicit programming. Data that can be analyzed through machine learning are broad and include, but are not limited to, numerical data, images, text, and speech or sound. A common manner with which to conceptualize machine learning is to consider the type of learning algorithm used to solve a problem: supervised learning, unsupervised learning, and reinforcement learning.8 Each of these types of learning algorithms has a range of techniques that can be applied and will be covered in the next section. Supervised learning is a task-driven process by which an algorithm(s) is trained to predict a prespecified output, such as identifying a stop sign or recognizing a cat in a photograph. Supervised learning requires both a training dataset and a test dataset. The training dataset allows the machine to analyze and learn the associations between an input and desired output while the test dataset allows for the assessment of the performance of the algorithm on new data. In many studies, one large dataset is subdivided into a training set and a test set).

Biography (200 words)

Vincenzo Piuri is a Professor at the University of Milan, Italy and has been Visiting professor at the University of Texas at Austin, USA, and visiting researcher at George Mason University, USA. His research interests are: intelligent systems, signal and image processing, pattern analysis and recognition, machine learning and industrial applications. Original results have been published in 400+ papers. He is a Fellow Member of the IEEE, ACM Distinguished Scientist, and Senior Member of INNS. He has been IEEE Director, IEEE Vice President for Technical Activities (2015), and President of the IEEE Computational Intelligence Society. He is Editorin-Chief of the IEEE Systems Journal (2013-19).

Info of Institute & Lab (200 words)

Founded in 1924, the University of Milan is a research-intensive university, offering high quality teaching at all levels in a broad spectrum of fields. Over the years, it has succeeded in maintaining a skillful blend of tradition and innovation, adjusting to the requirements of a fast-growing society without putting aside its distinctive traits.The university's interdisciplinary vocation and connections between a wide range of fields result in a highly stimulating and rich offer of undergraduate, graduate, doctoral and specialization courses with Italian being the main language of teaching. There is also a wide offering of degree programs available in English. As one of the top international institutions in terms of scientific productivity, the University of Milan's wide range of educational and research competencies and its relationships with the business world also make it an important resource for its socio-economic context.

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