Research Article

Knowledge, Attitudes and Perspectives of Anesthesiologists on Artificial Intelligence

🆔 **Ali Muhittin Tasdogan**

Department of Anesthesiology and Reanimation, Hasan Kalyoncu University Health Sciences Faculty, Gaziantep, Turkey

Abstract

Objectives: The use of AI in medicine is increasing every passing day. However, there is still debate in the literature among specialists about several aspects of artificial intelligence (AI). The objective of this study was to evaluate and analyze knowledge, attitudes and perspectives of anesthesiologists on AI through an online survey.

Methods: An online survey was conducted in order to reveal knowledge, attitudes and perspectives of anesthesiologists on AI in Turkey. The survey consisted of 29 questions about participants' demographic data, professional data, and opinions on AI. After physicians other than anesthesiology and reanimation specialists were excluded, responses of the remaining 68 anesthesiologists were evaluated and analyzed.

Results: The rate of anesthesiologists that have sufficient knowledge of AI was found as 36.8%. Of the respondents, 58.8% considered that AI offers useful applications in the field of medicine. 64.7% of the participants think that AI will create drastic changes in all fields of medicine. Only 2.9% of the anesthesiologists consider that AI will completely replace physicians in the near future. 5.9% of the participants reported that they are worried about developments in AI.

Conclusion: AI is not expected to completely replace physicians. We believe that further similar survey studies should be conducted in order to take physicians' opinions into account in the development of using AI in medicine.

Keywords: Artificial intelligence (AI), anesthesia, anesthesiologist

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Modern medicine face with challenges about acquiring, analyzing and implementing a huge amount of knowledge necessary for resolving complex clinical problems. The development of medical artificial intelligence (AI) has been parallel with the development of AI programs that intend to help clinicians the formulation of diagnosis, making therapeutic decisions, and predicting the outcome. These programs support healthcare professionals in everyday tasks and help them in the tasks based on the manipulation of data and information. These programs are used in clinic diagnosis, image analysis in radiology and histopathology and in data interpretation in intensive care setting. In terms of prognosis, medical AI programs are suitable for the analysis of cancer data with their ability to use non-linear relationships between the variables. It has been shown that AI programs can predict survival in patients with breast and colorectal cancers.[1]

The concept of AI in anesthesiology has existed for decades. First machines have been used in the 1950s in order to automate anesthetic delivery by reading electroencephalograms (EEG), to monitor depth of anesthesia (DOA) and subsequently to administer volatile anesthetics.

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[2] AI has been utilized in postoperative pain management and chronic pain fields with the development of programs enabling individualized care by predicting analgesia response.[3]

However, the full impact of AI in medicine has not yet been realized.[4] There is a diversity of views among experts on this issue in the literature. Some anesthetists argue that we should rely on scientific and technological innovation and allow anesthesia robots to perform some of the work of anesthesiologists. Therefore, it is thought that the contradiction between shortage of anesthesiologists and the need to develop high-quality anesthesia would be resolved.[5] On the other hand, some experts believe that AI can not realize many decision making areas that humans routinely make and since AI draw conclusions by analyzing numerous patent data, it may yield false results in the case of insufficient data.[6]

While there are many potentials for the use of AI in the field of anesthesia, AI and ML are yet very new and their development is constantly continuing. It is obvious that AI will be increasingly used in anesthesia as in other medical fields in the near future. Today the leading technology and informatics companies are making large amounts of investment in medical AI. It is important to receive expert opinions about the use of AI in anesthesia applications and to utilize these opinions for the development of AI. There is no study in the literature to evaluate opinions of anesthesiologists about AI.

Therefore, the objective of this study was to evaluate and analyze knowledge, attitudes and perspectives of anesthesiologists on AI through an online survey.

Methods

The study was designed as a survey. An online survey was conducted between 01/09/2019 and 30/09/2019 in order to reveal knowledge, attitudes and perspectives of anesthesiologists on AI in Turkey. The survey was arranged in two sections by utilizing the relevant literature. The first section consisted of 6 questions including age, gender, professional title, duration of professional experience, and institutions. The second section of the survey included 23 questions that measure knowledge levels and thoughts of the participants about AI, and their opinions about future impact of AI in medicine. Likert-5 scale was used in 19 questions in this section. The responses consisted of 1: strongly agree, 2: agree, 3: undecided, 4: disagree, and 5: strongly disagree. The remaining 4 questions were prepared as multi-choice in order to receive various opinions of anesthesiologists on AI. The survey was uploaded to a website and then was pronounced through online sources such as social media including FaceBook, Instagram, Twit-

ter and Whatsapp. A total of 188 physicians completed the survey at the end of the deadline. After physicians other than anesthesiology and reanimation specialists were excluded, responses of the remaining 68 anesthesiologists were evaluated and analyzed.

In the analysis of the obtained data, continuous variables are expressed as mean±standard deviation, median, minimum and maximum values, and categorical variables as frequency (n) and percentage (%).

Results

A total of 68 anesthesiologists who completed the survey were included in the study. Of the participants, 70.6% (n=48) were male and 29.4% (n=20) were female. The mean age of the participants was 37.6±8.21 years with a median of 39 (min-max: 25-55) years. The mean age was found as 37.1±8.21 years in male and 38.6±8.1 years in female participants. Of the participants, 7 were working in a public hospital, 6 in a training and research hospital, 37 in a university hospital and 18 in a private healthcare center (Fig. 1).

When professional titles of the participants were examined; the highest rate of title was physician associate (n=32) (Fig. 2).
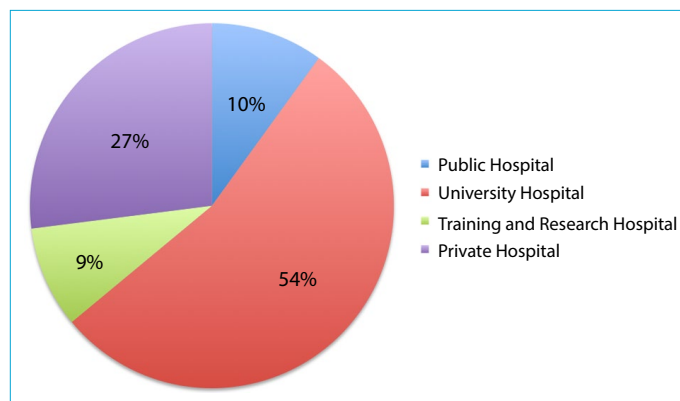

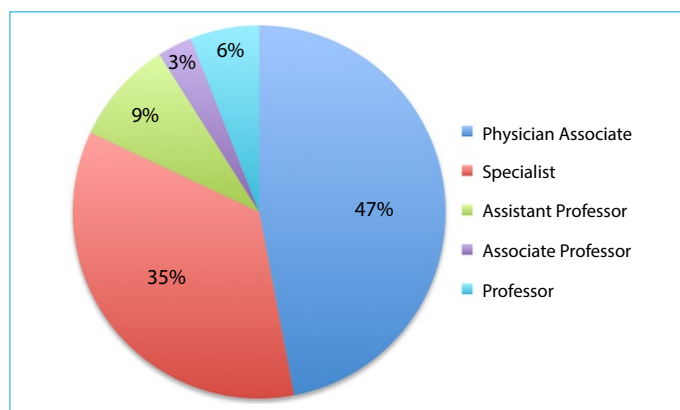**Figure 1.** Distribution of participants' institutions.

Figure 2. Distribution of participants' professional titles.

Durations of professional experience were divided into four groups as 1-4 years, 5-9 years, 10-19 years and ≥20 years. Accordingly, duration of professional experience was found as 10-19 years in 39.7% (n=27), 1-4 years in 25+ (n=4), 5-9 years in 19.1% (n=13) and ≥20 years in 16.2% (n=11) of the anesthesiologists.

When responses given to the survey were evaluated; 72% of the participants reported that they follow-up emerging technologies. The rate of anesthesiologists that have sufficient knowledge of AI was found as 36.8%. Of the respondents, 58.8% considered that AI offers useful applications in the field of medicine. When asked whether the AI would lead to drastic changes in various fields of medicine, 70.6% of the anesthesiologists think that AI would lead to drastic changes in the field of radiology, 66.2% in the field of oncology, 63.2% in the field of microbiology and biochemistry, and 64.7% in all fields of medicine.

When the diagnostic and treatment skills of AI were questioned; only 10.3% of the physicians reported that the ability of AI to establish a diagnosis may outweigh the clinical experience of physicians. Again, the rate of participants who think that the ability of AI to order a treatment may outweigh physicians was only 11.8%.

The rate of the respondents who consider that AI will replace radiologists in near feature was found as 17.6%, oncologists as 11.8%, and microbiologists as 19.1%. Only 2.9% of the anesthesiologists consider that AI will completely replace physicians in the near future. 5.9% of the participants reported that they are worried about developments in AI. 76.5% of the anesthesiologists who participated in the survey think that AI will be a part of medical education. 32.4% of the participants think that they will always use AI when making medical decisions in the near future (Fig. 3).

Of the participants, 23.5% think that it would be wise to choose a field of medicine where AI cannot be dominant in the selection of specialty. Of all participants, 64.7% think that the use of AI in the field of medicine would provide significant economic contribution.

When the participants were asked the biggest advantage of using AI in the field of medicine; 32.4% reported that AI can provide large amounts of high quality data storage and presentation. Of the participants, 29.4% reported that AI can minimize the number of human-induced medical errors, 14.7% reported that AI can accelerate the developments in the healthcare system, and 23.5% stated that AI can well analyze other factors such as genetic and environmental factors, providing the best approach in diagnosis and treatment.

When the anesthesiologists were asked which they will follow when their medical decisions and decision support
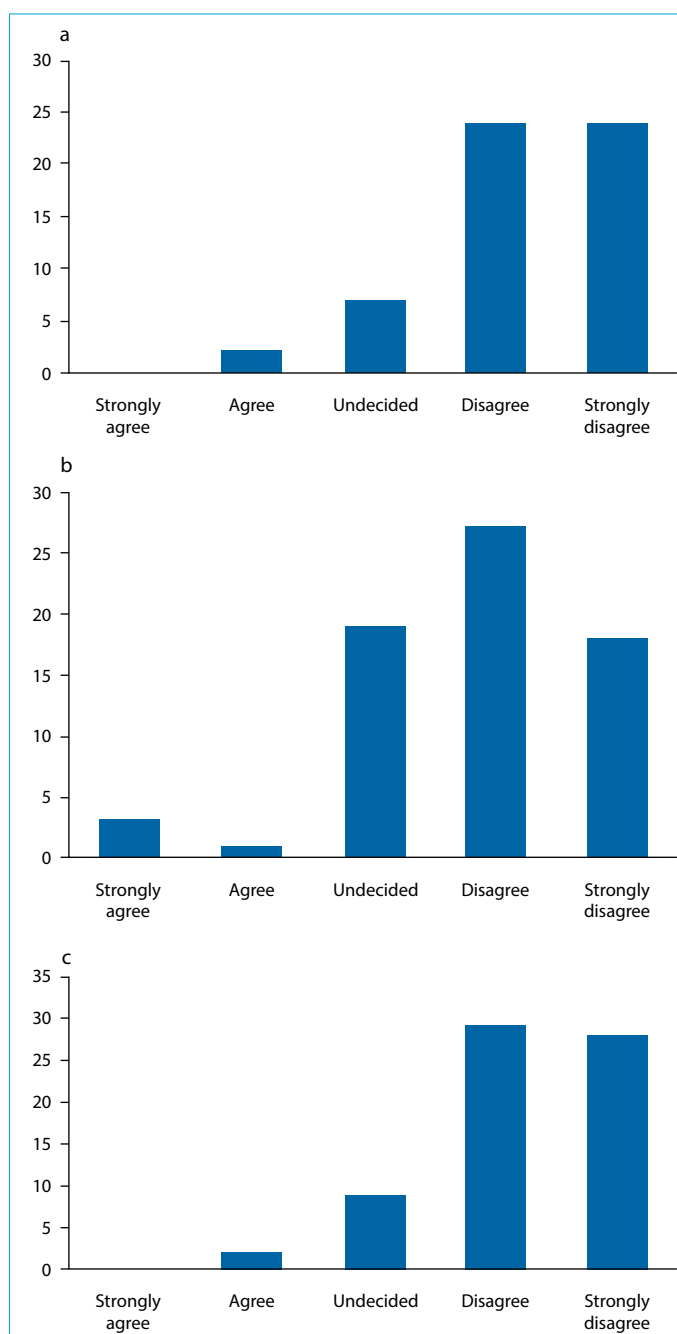

Figure 3. (a) I think that in the near future, AI will completely replace physicians. **(b)** I am worried about developments in AI. **(c)** I think AI can take my professional place.

diagnoses of AI differ; 94.1% reported that they will follow their own decisions. When the anesthesiologist were asked which field of AI would be most useful; 35.3% reported biopharmaceutical research and development, 4.4% direct treatment methods including surgical techniques, 5.9% in the development of social insurance program, 7.4% in ordering treatment, 8.8% in providing medical support in the geographic regions where access to medical facilities is limited and 38.2% in establishing a diagnosis.

When the participants were asked what they were concerned about the AI implementations in the field of medicine; 5.9% of the participants reported that AI can not be consulted in rare cases of insufficient notification. Of the participants, 26.5% think that AI is insufficient to observe emotional status of the patient. Of the anesthesiologists, 32.4% think that AI is not flexible enough to be applied in all patients. While 22.1% of the participants reported that AI is difficult to decide on controversial issues, 13.2% reported that they are concerned about the development of AI by a less experienced specialist on medical applications. The results of the survey are given in Table 1.

Distribution of various opinions of the anesthesiologists on AI according to the duration of professional experience are given in Table 2.

Discussion

Many AI experts think that long term technological developments will increase the effectiveness of healthcare delivery through advancements in medicine and diagnostic accuracy, inexpensive access to health services and decrease

in workload of physicians.[7–9] In recent years, increasing availability of health data and rapid development of big data analysis methods have enabled successful applications of AI in the field of medicine. The development and utilization of AI programs have entered to commercialization phase.[10] However, debate is continuing in the literature on the use of AI in the field of medicine. Some studies have reported that the rate of recognition of AI is still low among medical specialists.[11, 12] On the other hand there are studies reporting a high rate of recognition of AI by physicians.[13]

To our best knowledge, this study is the first in the literature to evaluate opinions and attitudes of anesthesiologists on AI. In our study, in general participants think that AI is useful in the field of medicine, will create drastic changes in the fields of radiology, oncology as well as every field of medicine, but is sufficient compared to physicians, and cannot replace them. In our study, the rate of having sufficient knowledge of AI was found as 36.8% among the participants. Again 58.8% of the participants think that AI is useful in the field of medicine. A survey study by Oh et al. evaluating attitudes of Korean physicians toward AI includ-

Table 1. Results of the survey conducted to measure opinions of the anesthesiologists on AI

OPINIONS	n (%)			
	1	2	3	4
I follow emerging technologies.	12 (17.6)	37 (54.4)	16 (23.5)	3 (4.4)
I have sufficient knowledge of AI.	2 (2.9)	23 (33.8)	20 (29.4)	16 (23.5)
AI offers useful applications in the field of medicine.	6 (8.8)	34 (50.0)	26 (38.2)	2 (2.9)
I think that AI would lead to drastic changes in the field of Radiology.	10 (14.7)	38 (55.9)	16 (23.5)	4 (5.9)
I think that AI would lead to drastic changes in the field of Oncology.	11 (16.2)	34 (50.0)	17 (25.0)	5 (7.4)
I think that AI would lead to drastic changes in the field of Microbiology and Biochemistry.	10 (14.7)	33 (48.5)	19 (27.9)	6 (8.8)
I think that AI would lead to drastic changes in every field of medicine.	9 (13.2)	35 (51.5)	18 (26.5)	5 (7.4)
I think that the ability of AI to establish a diagnosis may outweigh clinical experience of physicians.	0 (0)	7 (10.3)	18 (26.5)	33 (48.5)
I think that the ability of AI to order a treatment may outweigh physicians.	0 (0)	8 (11.8)	12 (17.6)	32 (47.1)
I think that AI will completely replace radiologists in the near future.	1 (1.5)	11 (16.2)	22 (32.4)	25 (36.8)
I think that AI will completely replace oncologists in the near future	1 (1.5)	7 (10.3)	19 (27.9)	30 (44.1)
I think that AI will completely replace microbiologists in the near future	2 (2.9)	11 (16.2)	17 (25.0)	28 (41.2)
I think that AI will completely replace physicians in the near future.	0 (0)	2 (2.9)	7 (10.3)	24 (35.3)
I am worried about the developments in AI.	3 (4.4)	1 (1.5)	19 (27.9)	27 (39.7)
I think that AI can take my professional place.	0 (0)	2 (2.9)	9 (13.2)	29 (42.6)
I think AI will be a part of medical education.	12 (17.6)	40 (58.8)	10 (14.7)	5 (7.4)
I think that I will always use AI when making medical decisions in the near future.	2 (2.9)	20 (29.4)	22 (32.4)	19 (27.9)
I think that it would be wise to choose a field of medicine where AI cannot be dominant in the selection of specialty.	5 (4.7)	11 (16.2)	18 (26.5)	23 (33.8)
I think that AI will provide significant economic contribution.	9 (13.2)	35 (51.5)	14 (20.6)	4 (5.9)

1: strongly agree; 2: agree; 3: disagree; 4: strongly disagree; artificial intelligence: AI.

Table 2. Distribution of participants' opinions on AI according to the duration of professional experience

OPINIONS	Duration of professional experience						
	1-4 years		5-9 years		10-19 years		≥20 years
	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree
	n (%)		n (%)		n (%)		n (%)
I have sufficient knowledge of AI.	5 (7.4)	7 (10.3)	2 (2.9)	6 (8.8)	11 (16.2)	6 (8.8)	7 (10.3)
I think that AI would lead to drastic changes in every field of medicine.	11 (16.2)	3 (4.4)	8 (11.8)	1 (1.5)	18 (26.5)	1 (1.5)	7 (10.3)
I think that the ability of AI to order a treatment may outweigh physicians.	4 (5.9)	12 (17.6)	2 (2.9)	8 (11.8)	1 (1.5)	20 (29.4)	1 (1.5)
I think that AI will completely replace physicians in the near future.	1 (1.5)	12 (17.6)	0 (0)	11 (16.2)	1 (1.5)	24 (35.3)	0 (0)
I am worried about the developments in AI.	0 (0)	14 (20.6)	1 (1.5)	9 (13.2)	3 (4.4)	16 (23.5)	0 (0)
I think that AI can take my professional place.	2 (2.9)	14 (20.6)	0 (0)	11 (16.2)	0 (0)	22 (32.4)	0 (0)
I think that I will always use AI when makin medical decisions in the near future.	6 (8.8)	8 (11.8)	3 (4.4)	3 (4.4)	9 (13.2)	10 (14.7)	4 (5.9)

ed three sections as recognition of and attitudes toward AI, direction of AI development in the field of medicine and potential risk of using AI in medicine. A total of 669 physicians completed the survey. Of all participants, only 5.9% reported good familiarity with AI. Majority of the participants (83.4%) think that AI is useful in the field of medicine.[12] We think that the difference between the results of the studies might be resulted from different numbers of participants and including only anesthesiologists in our study.

In our study, only 2.9% of the participants think that AI will completely replace physicians in the near future, and only 5.9% reported that they worried about the developments in AI. In the literature, studies including surveys conducted on various medical specialists have reported different results. In an international survey study by Sarwar et al. evaluating attitudes and perspectives of pathologists about AI (487 participants), participants were asked whether AI will replace pathologists in future. Of the participants, 38% reported that AI will not affect employability, and 42.4% stated that AI will create new positions, increasing employment. Only 17.6% of the participants were worried about displacement of humans by AI.[13] In the survey by Oh et al., 35.4% of the Korean physicians think that AI will replace physicians.[12] Again in a survey conducted with psychiatrists in Duke University and Harvard Medical School, only 4% of the participants reported that AI will replace them. In the same study, psychiatrists reported that AI is not likely to replace themselves in terms of complex tasks such as mental status examination by 67%, assessment of the risk of violence by 58% and determination of the need for hospitalization by 55%.[14] In a study by Blease et al.[11] from United Kingdom evaluating opinions of family physicians

on AI, 68% of the participants reported that technology is not likely to completely replace physicians in future. In the same study, 61% of the respondent reported that technology is not likely to replace physicians in terms of referral of patients to other healthcare professionals. Majority of participants (94%) reported that technology cannot provide empathic care as physicians or better than them.[11]

In a survey conducted with 4135 participants by Pew Research Center in 2017, 72% of the participants reported concerns about a future in which robots and computers can perform many human jobs.[15] Unlike other professionals, physicians think that there will be difficulties in replacing physicians. Given its limitations, it was argued that AI cannot replace physicians at bedside.[16] AI cannot be involved in a high-quality conversation with patients in order to gain trust or express empathy.[17] These are important factors in the relationship between the physician and the patient. In addition, although AI provide valuable information that may be helpful for the diagnosis, interpretation of physicians will be needed in order to integrate medical information, perform a physical examination and other evaluations.[16]

In the present study, 94% of the participants reported that they will prefer their own decisions when their medical decisions and decision support diagnoses differ. In the study by Oh et al.,[12] when the participants were asked which will you prefer when your own judge and that of AI differ, 78.9% of the participants responded as physician's judge.

When the studies were evaluated overall, physicians find AI beneficial, think that AI will be increasingly used in various fields of medicine, but it is not likely to replace physicians. Studies have reported that AI will be the most useful in

patient documentation, medical records and synthesis of data to reach a diagnosis.[11, 14, 18]

This study has some limitations. First, the number of our participants is relatively low. In addition, questions directly related to anesthesia applications were not included in the survey. Finally, background technical questions could be included to measure actual knowledge levels of the participants about AI. However, the strength of this study is being the first in the literature evaluating opinions and attitudes of anesthesiologists on AI.

Conclusion

The results of this study revealed that anesthesiologists find AI useful in various fields of medicine, and think that AI will create drastic changes in the fields of radiology, oncology, microbiology and biochemistry as well as every field of medicine. However, AI is not expected to completely replace physicians. We believe that further similar survey studies should be conducted in order to take physicians' opinions into account in the development of using AI in medicine.

Disclosures

Ethics Committee Approval: The study was approved by the local ethics committee of Gaziantep Hasan Kalyoncu University.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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