Advantages of introduction of Machine learning into Patient-Controlled Anesthesia in Chronic Obstructive Pulmonary Disease and Congestive Heart Failure

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Chronic obstructive pulmonary disease (COPD) and congestive heart failure (CHF) are significant global health challenges that often coexist in the terminal stages.[1] In CHF, the heart fails to deliver sufficient oxygen to tissues for their functioning. In COPD, airway obstruction leads to breathing issues. Atrial fibrillation (AF) is the most prevalent cardiac arrhythmia that is characterized by a rapid and irregular heart rhythm, and coronary artery disease (CAD) or ischemic heart disease is a heart disease in which blood flow to the heart muscle is reduced due to an obstruction in the arteries supplying it. CAD and AF often coexists, and their management can be quite challenging.[2] These conditions are life-threatening and share symptoms such as fatigue, cachexia, depression, severe pain, and dyspnea.[3] For the terminal care of patients, patient-controlled anesthesia (PCA) offers liberty and better pain management. However, the conventional PCA is limited by issues such as overdosage, underuse, and inadequate monitoring. These problems can be substantially mitigated by employing artificial intelligence (AI). AI can help personalize care by automatically tracking and adjusting the dosages, thereby alleviating symptoms and minimizing the burden on caregivers.[4]

In the terminal stages of CHF and COPD, the patient and their caregivers can be overwhelmed, the physiological and mental suffering as well as the associated high societal and financial stress in such individuals are similar those experienced by patients with cancer. The patients become isolated and immobile, and there is a frequent need for bedside care. Patients can experience symptoms such as worsening dyspnea, excess fluid buildup, discomfort, anxiety/depression, and generalized fatigue. They may also experience non-specific symptoms such as severe pain that cannot and should not be disregarded.[5]

PCA can play a pivotal role in uplifting a patient's quality of life. However, some frailty and shortcomings associated with the conventional PCA may prove life-threatening when not addressed appropriately. Caregiver inexperience or negligence can lead to errors in grading the severity of symptoms, dosage calculations, and timing. A case report demonstrated severe opioid-induced respiratory depression in a patient with heart disease who eventually died.[6] Because of the potential complications, the PCA protocols must be improved with AI to mitigate the adverse effects and effectively handle the symptoms.[7]

AI can be of substantial value in PCA. Via wearable devices, AI can monitor the vitals, assess the pain and degree of symptoms, predict improvements and potential exacerbations, and appropriately adjust the dosage. Over time, it can significantly alleviate symptoms, augment independence, and elevate the dignity and quality of life of the patients.[8]

In conclusion, patients with terminal stages of CHF and COPD require advanced care protocols, and the current PCA protocols for such patients are deficient. Studies have demonstrated that AI can enhance palliative care practices in patients with cancer.[9] Likewise, the outcome of several comorbidities of the cardiovascular system can be significantly improved by using AI in patient care. AI can refine the diagnosis and optimize the therapy of CAD and AF.[10] Thus, to achieve the desired positive outcomes, CHF and COPD-centric AI algorithm should be introduced in PCA protocols. This will amplify end-of-life support via the efficient manasgement of symptoms, promotion of targeted care and their safety, and prevention of potential aggravations. Furthermore, this will reduce the burden on caregivers.[4] Nonetheless, clinical trials must be conducted to confirm the safety and productiveness of AI in PCA for patients with end-stage COPD and CHF. Furthermore, these studies must be focus on the moral and operational concerns, such as patient confidence, privacy assurance, and user-friendliness, of deploying AI in PCA. Considering

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Received: October 15, 2024 **Accepted:** November 05, 2024 **Available Online Date:** xxxxxx • **DOI:** 10.4274/balkanmedj.galenos.2024.2024-10-64

Available at www.balkanmedicaljournal.org

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Cite this article as: Khan SM, Hassan SA, Rubab F. Advantages of introduction of Machine learning into Patient-Controlled Anesthesia in Chronic Obstructive Pulmonary Disease and Congestive Heart Failure. Balkan Med J.;

the potential of AI, its implementation in PCA may substantially improve symptom management in these weakening conditions.

Authorship Contributions: Concept- S.M.K., S.A.H., F.R.; Design- S.M.K., S.A.H., F.R.; Supervision- S.M.K., S.A.H., F.R.; Data Collection or Processing- S.M.K., S.A.H., F.R.; Literature Search- S.M.K., S.A.H., F.R.; Writing- S.M.K., S.A.H., F.R.

Conflict of Interest: No conflict of interest was declared by the authors.

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