

Robotics and the Airway Management

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The definition of the word 'Robot' was first given by Josef Capek in 1920; who used the word in the title of a play by the name of "Rossum's Universal Robots". As per the definition of Encyclopaedia Britannica robot is "any automatically operated machine that replaces human effort, though it may not resemble human beings in appearance or perform functions in a humanlike manner". The role of robots in surgery and anaesthesia is now a reality. Since the approval by FDA in year 2000, surgeons have been using Da Vinci surgical robot in more than 1500 hospitals in USA. In the last 20 years, surgeons have shifted to small incision surgical procedures with the help of surgical robot among other techniques.

Recently the robotic advancement has entered the field of anaesthesia in various ways. Anaesthesiologists work in a complex environment both in Intensive Care and operating rooms where their technical skill is required [1].

The fatigue builds up and alertness is impaired compromising the safety of the patients. Robots may help in taking away this workload by keeping the patient data and doing some manual jobs and decision-making [2]. This would improve the precision and safety outcome in surgical patients.

Two kinds of robots have been inducted in anaesthesia i.e. Pharmacological robots and Mechanical (manual) robots [3].

The pharmacological robots can titrate the anaesthetic drugs and monitor anaesthetic parameters. It is a system that delivers drug by closed-loop or a feed-back technique. It measures variable and compares it to desired target value or a set point. Closed Loop Anaesthesia Delivery (CLAD) system automatically delivers the anaesthetic drugs to the patient and anaesthetist is free from monitoring the depth of anaesthesia repeatedly. An automated anaesthetic system by the name of 'McSleepy' has been developed by Dr. Thomas Hemmerling (McGill University Health Centre, Montreal) that delivers drugs and monitors vital parameters in patients under surgery. The depth of anaesthesia, analgesia and neuromuscular block are almost continuously monitored. It adds to the safety of the patient and the outcome.

The role of robots in managing airway has been achieved by Mechanical robots. This robot replaces manual movements of the anaesthesiologist. Two major areas of this kind of robot are tracheal intubation and regional anaesthesia. In the first experiment, Da Vinci surgical system (Intuitive Surgical, Inc., Sunnyvale, CA, USA) was used to perform tracheal intubation. Two simulated tracheal intubations were performed by Tighe et al in 2010, using fiberoptic that proved to be a success

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but technically hard due to robot design with multiple robotic arms [4].

Figure 1- The ‘Kepler Intubation System (KIS) being used for tracheal intubation in patients

(Photos courtesy: McGill University Health Centre, Montreal, Canada)



The development of ‘Kepler Intubation System’ (KIS) by Hemmerling et al (2012) [5] This system has one robotic arm connected to a video-laryngoscope on one side and is controlled by a joy-stick on the other side using a remote control (Figure 1) Intubation may be performed automatically under direct vision with greater precision.

In a study of 90 simulated intubations, the time taken was 40 to 60 seconds and all intubations were successful in the first attempt [5]. In a study involving 12 patients, success rate was 91% and mean time for intubation was 93 seconds with no complications observed.

The process of tracheal intubation may be a complex exercise at times that requires skill and experience.

Difficult airway may be due to patient characteristics but individual approach and skill of the anaesthesiologist also makes the difference in securing the airway. An intubation that appears effort less and unproblematic in the hand of one anaesthesiologist can be complicated or even impossible with the other.

These factors may be minimised when robotic intubation system is employed since it can help the hands of the anaesthesiologist to carry out manual jobs with minimal force, safety and advanced precision.

In future, robotic intubation system might be the routine practice of managing the difficult airway.

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