Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 2s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Liability in Robotic Surgery: Legal Frameworks and Case Studies

Dr. M.B. Bagwan[1], Ms. Tanya Joshi[2], Dr. Rahul Atul Goswami[3], Dr. Ravindra S. Patil[4], Dr. Vandana Sharma, Dr. Lalita Kiran Wani

[1]Assoc. Prof., Dept. of Surgery, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth "Deemed to be University",Taluka-Karad, Dist-Satara, Pin-415 539, Maharashtra, India,

Email ID: rafiquemrb@yahoo.com

[2]Teaching Assistant, Symbiosis Law School, Nagpur campus, Symbiosis International (Deemed University) Pune, India,

Email ID: tanyajoshi@slsnagpur.edu.in

[3]Dept. of Surgery, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth "Deemed to be University",Taluka-Karad, Dist-Satara, Pin-415 539, Maharashtra, India,

Email ID: dr.rahulgoswami53@gmail.com

[4]Associate Professor, Dept. of Emergency Medicine, Krishna Institute of Medical Sciences, Krishna Vishwa Vidyapeeth "Deemed to be University",Taluka-Karad, Dist-Satara, Pin-415 539, Maharashtra, India,

Email ID: ravipatilich@gmail.com

Dr. Vandana Sharma, Arya College of Pharmacy, Jaipur, Rajasthan, India. 0000-0001-7985-097X

Dr. Lalita Kiran Wani, Bharati Vidyapeeth's College of Engineering, Lavale,Pune, India.

Email ID: lalita.wani@gmail.com

Cite this paper as: Dr. M.B. Bagwan, Ms. Tanya Joshi, Dr. Rahul Atul Goswami, Dr. Ravindra S. Patil, Dr. Vandana Sharma, Dr. Lalita Kiran Wani, (2025) Antidiabetic Potential of Emodin in Streptozotocin-Induced Type-2 Diabetic Rats. *Journal of Neonatal Surgery*, 14 (2s), 70-77.

ABSTRACT

Because it promises better results, shorter healing times, and high accuracy, robotic surgery which uses modern technology to help doctors do minimally invasive procedures has become very popular very quickly in the medical world. But using robots in surgery brings up difficult legal questions about who is responsible. The main point of this argument is who is responsible when there are medical mistakes or malpractice. This essay looks into the law aspects of robotic surgery and uses case studies to figure out who is responsible for what: medical schools, doctors, and companies that make robotic systems. By looking at the current state of medical malpractice rules in relation to robotic surgery, it shows that there are problems with how responsibility is assigned. Some of the important things that were talked about were the duty of surgeons, the role of medical institutions in making sure that the right training, maintenance, and system changes happen, and the purpose of companies that make robotic systems. By looking at actual court cases, the paper is able to bring up legal examples and issues that could help guide future hearings on robotic surgery malpractice. The goal is to study how to make better law systems that can keep up with how medical technology changes and protect patients' rights. The study also stresses the need for rules to keep up with changes in technology and for healthcare workers to fully understand their legal duties when it comes to robotic surgery.

Keywords: *Robotic Surgery, Legal Liability, Medical Malpractice, Surgeon Responsibility, Medical Technology Law*

1. INTRODUCTION

By allowing more exact treatments with less patient injury and improved recovery periods, using robots in surgery has transformed the world of medicine. Operating rooms all throughout the globe now use robotic equipment like the da Vinci Surgical System and robotic-assisted laparoscopic surgery on regular basis. During delicate operations, these devices enable surgeons to be more deft and exact. Computer systems have raised several challenging moral and legal issues even if they provide a lot of possible advantages. The rules controlling robotic surgery must adapt to handle fresh problems like who is accountable and liable for medical errors or malpractice as the number of users of this technique increases. One of the main concerns with robotic surgery is who bears accountability should anything go wrong during the operation. Charges of medical

fraud used to hold the surgeon or other healthcare practitioner accountable for any errors made during operation [1]. But robots complicate this basic thinking's grasp. Should anything go wrong during a computer-assisted operation, it is not always apparent who should be accountable—the surgeon, the hospital, or the firm creating the robotic equipment. Although the work of the surgeon is still very crucial, the surgery depends much on the robotic system. This begs questions about whether the error resulted from flaws in the system itself, its architecture, or its software. Furthermore under consideration is whether hospitals and other medical institutions may be held liable for failing to ensure that robotic devices get the required training, maintenance, and testing—all of which are essential for them to operate as intended [2].

The long-standing rules that have been in place often fail to fit these contemporary challenges. Many countries have seen their laws against medical fraud fall short in keeping with developments in medical technology. Although several legal systems have begun to include robots into the voting process, there are still many areas where it is unclear what the law permits. For example, the guidelines already in place on informed consent would not be sufficient to address the complex nature of procedures using robots suitably. Some patients may find it difficult to make wise decisions as they may not completely know what the computer system is doing throughout their therapy [3]. Moreover, the role that creators of robotic systems contribute to the risk picture is continually evolving. Manufacturers might argue that because the surgeon still oversees the system, they are not accountable for errors committed during procedures. But damaged components, software faults, or poor system design might cause litigation against producers. Case studies of errors made during robotic surgery provide a great deal of information on how these legal concerns are presently handled and how they could evolve going forward. In several well-known incidents, errors in robotic surgery have seriously harmed or even killed people. As they attempt to determine who is at blame, those engaged in these cases often enter protracted legal battles. For instance, it is unclear who the operator or manufacturer of a robotic system is should it malfunction. Robotics technology is continually evolving, hence a legal system that can remain current is really necessary. This entails ensuring that appropriate regulatory agencies monitor the advancement, testing, and use of robotic systems in medical environments.

2. THE EVOLUTION OF ROBOTIC SURGERY

A. History and Development of Robotic Surgery Technologies

The concept of robotic surgery was already there even if robotic instruments were only beginning to be used in medicine in the early 1980s. Originally designed to assist with medical treatments, particularly minimally invasive procedures, the initial models Made at the University of California in 1985 to assist with joint therapies, the "Arthrobot," one of the first instruments, Since this method was developed, robotic-assisted surgery has evolved greatly. Robotic surgery came a great way when Intuitive Surgical unveiled the da Vinci Surgical System in 1999. The da Vinci machine gave to the profession the capacity for surgeons to execute difficult operations more accurately and with less harm, therefore transforming the sector. More exact and flexible motions than with conventional laparoscopic surgery were made feasible by the high-definition 3D imagery, sophisticated robots, and simple settings on this robotic system [4]. Thanks to developments in robots, software algorithms, and artificial intelligence (AI), robotic surgical systems have grown more dependable, user-friendly, and valuable across a greater spectrum of medical disciplines over years. As these technologies have developed in fields such urology, paediatrics, cardiology, and orthopaedics, robotic surgery has become more beneficial [5].

B. Benefits of Robotic Surgery for Precision, Minimally Invasive Procedures, and Patient Outcomes

Particularly in terms of precision, techniques causing the least amount of harm, and patient recuperation, robotic surgery offers several benefits over open operation. The primary advantages are that it enables physicians to be more dexterous and exact. Robotic devices enable surgeons to more accurately and in high definition observe and manipulate surgical equipment, therefore facilitating their performance of difficult operations in remote locations [6]. Smaller incisions, less tissue damage, and less stress on surrounding structures made possible by this hastens the healing process. Furthermore less likely to occur with minimally invasive surgery are infections, scars, and other issues arising from open procedures. Shorter hospital stays, less discomfort after surgery, and a quicker return to regular activities follow from smaller incisions and faster healing. Given their lesser scars, patients also feel better about their appearance. Robotic surgery may also provide more consistent outcomes as robots can conduct highly repetitive jobs precisely, hence reducing human error. For very sensitive and difficult procedures like removing prostate cancer or repairing a heart valve, this is quite beneficial. Robotic surgery is also employed in many hospitals worldwide as it is a better, quicker, and more patient-friendly approach of doing surgery.

C. The Role of Robotics in the Surgical Process and How It Complicates Traditional Liability Paradigms

Robotic surgery has brought complexity into the liability structure even as it has changed the surgical scene. In conventional surgery, responsibility is somewhat simple as the surgeon is responsible for any errors done during the operation. But the advent of robotic technology throws off this paradigm by integrating not only the surgeon but also the medical institution and the producer of the robotic device, therefore introducing many possible sites of failure. Although the surgeon is still the main operator, the robot is rather important for doing the procedure [7]. When a mistake happens, it's often difficult to know if the surgeon's actions, the malfunction of the robotic system, or the hospital's neglect of appropriate equipment maintenance were the major causes of the issue. For example, a mistake during surgery might result from a broken robotic arm brought

on by a mechanical failure or software problem. Under these circumstances, it becomes challenging to ascertain whether the manufacturer or the hospital should be held liable or if the surgeon is accountable for the failing outcome. Furthermore, the growing dependence on sophisticated algorithms and artificial intelligence in robotic systems begs issues regarding how to share accountability for mistakes the system produces. Legal systems might have to change as these technologies develop to handle these fresh levels of complexity. This calls for new legal precedents to direct liability decisions in robotic surgery cases [8] and a thorough awareness of the roles and obligations of surgeons, hospitals, and manufacturers.

III. Legal Frameworks for Medical Liability

A. Medical Malpractice Law and Its Application to Traditional Surgery

Medical malpractice laws have always been about holding doctors and nurses accountable for careless mistakes or actions that put patients in danger. When it comes to traditional surgery, the law usually says that the surgeon is responsible for providing an average level of care that meets medical standards and rules. If a surgeon doesn't follow these rules and a patient gets hurt, the doctor could be sued for malpractice [9]. Usually, to be found guilty of malpractice, you have to show that there was a duty of care, that it was broken, and that the breach directly hurt or damaged the patient. In traditional surgery, this duty of care is very clear: the surgeon is the main person doing the operation, so any mistakes are usually blamed on what he or she did or didn't do. If a hospital or other healthcare facility doesn't provide enough help, like by not having enough staff, keeping instruments in good shape, or giving medical teams enough training, that facility could also be held responsible. In standard surgery, on the other hand, the surgeon and the medical organisation are still mainly responsible, which makes for a very basic model of duty [10].

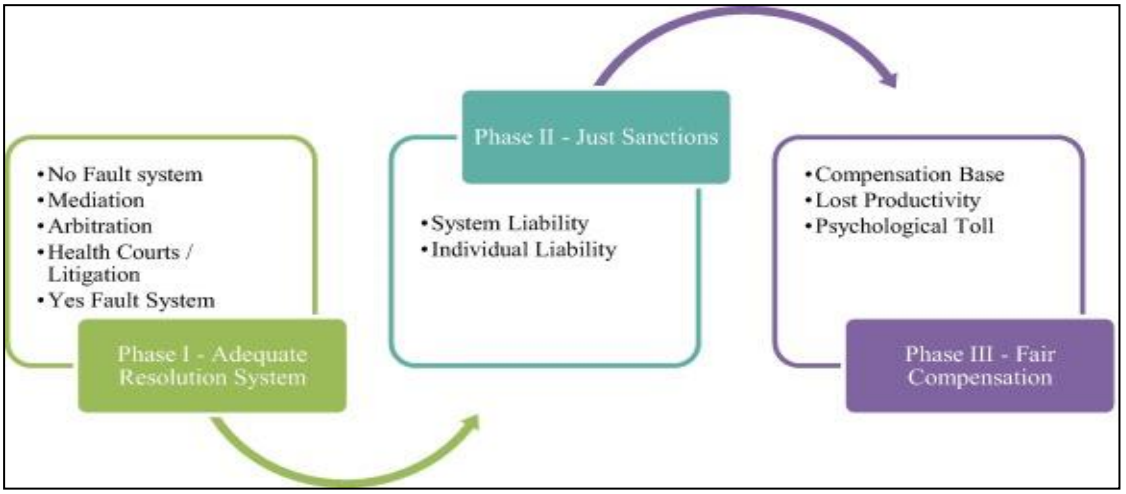

Figure 1: Overview of Malpractice Law and Its Application

B. Robotics in Surgery and the Legal Implications for Malpractice

Robotic surgery comes with a level of risk that is more complicated than with regular methods. In robotic-assisted surgery, the robot system helps the surgeon do the treatment, but the surgeon is still in charge. This makes me wonder if the company that made the robotic system could be held responsible if there was a problem with the design or if the surgeon is solely to blame for any mistakes that happen. When robotic systems fail during surgery, either because of a problem with the hardware, the software, or the tuning, it's harder to figure out who is to blame [11]. If the surgeon followed all the right steps and the robot still didn't work right, they might not be to blame. However, the court system needs to decide if the operator's job makes them finally responsible. The part of the hospital or medical organisation in making sure robotic systems work properly is also being talked about. If the equipment isn't properly aligned or cared for, the hospital could be held responsible. The growing use of artificial intelligence (AI) in computer systems makes things even more complicated. Making decisions with AI could lead to mistakes that are hard to trace back to human action, which brings up new questions about who is responsible. Because of this, medical malpractice rules need to change to reflect the many aspects of robotic surgery and the fact that makers, doctors, and hospitals are all responsible for it.

C. Challenges in Applying Existing Laws to Robotic Surgery: Gaps and Ambiguities

The current medical malpractice rules are hard to follow because the legal system isn't complete and there isn't enough information about robotic surgery. This is not how robotic-assisted surgery really works because traditional malpractice [12] rules were made thinking that human doctors would be the only ones doing the surgery. One big problem is that it's not always easy to figure out who is responsible when something goes wrong. If a robotic system fails during surgery, it might not be easy to tell if it was because of a mistake by the user, a problem with the software, or a flaw in the design. The next

legal question is who is responsible: the operator, the hospital, or the company that made the robotic system? Because of this, we need clearer rules and advice because the current law doesn't handle this complexity well. Artificial intelligence's ability to work with robots is another problem. It's not always clear in current law systems whether the surgeon or the AI is to blame when something goes wrong. However, systems that are run by AI may make choices based on data and formulas that the surgeon can't change. Also, informed permission, which is a key part of medical malpractice law, might not be enough to handle the complexity of robotic surgery. Patients who don't fully understand the technological side of robotic surgery might not get enough information about the risks that come with the devices. This can make people wonder if consent forms are really necessary and if doctors are responsible for teaching their patients how to use these tools. Due to the complexity of robotic surgery, the use of artificial intelligence, and the changing of roles among the many people involved [13], the legal system needs to make up for these gaps by creating more specific rules. Without these kinds of improvements, patients, doctors, hospitals, and makers would all be at risk of unknown lawsuit problems. It might also be hard to know what the legal effects of robotic surgery are.

3. LIABILITY IN ROBOTIC SURGERY: KEY LEGAL ISSUES

A. Surgeon's Responsibility in Robotic-Assisted Surgery

In robotic-assisted surgery, the robot conducts the actual walking throughout the operation while the surgeon remains in command of the procedure and controls and directs the robotic system. This division of work makes me question what the surgeon is accountable for should anything go wrong? Although the surgeon is still the primary operator, more and more people are realising that robotic systems—usually supposed to assist the surgeon in doing their job better—make it increasingly difficult to determine who is at blame. When anything went wrong after an operation, physicians used to be immediately liable for medical malpractice. Nevertheless, the use of robotic systems complicates this further. Should anything go wrong during surgery, it might be difficult to ascertain if the issue is with the robot, the nurse, or both. could the robot fail because to a software glitch or mechanical issue, for instance, could the surgeon be held accountable for the error? The surgeon is naturally also in charge of ensuring the robot operates as it should. Although the robot may assist with precise motions, it is still the surgeon's responsibility to ensure the device is in the correct location, under control, and maintained in excellent form during the operation. Should the surgeon neglect to utilise the robot correctly—that is, by misadjusting the parameters or failing to adapt to new conditions—it might be their responsibility. Should the surgeon not have received appropriate instruction on computer usage, it is also likely that he or she is accountable for what transpired. This means that in robotic-assisted surgery, a surgeon's role transcends mere operator; they also have to be knowledgeable in using the robotic technologies. Surgeons also have to understand the hazards involved with robotic operations. Before deciding if robotic assistance is appropriate for a patient or procedure, they must exercise great caution and do thorough study.

B. Liability for hospitals and other health care facilities

Regarding robotic-assisted surgery, various medical institutions like hospitals have also bearing responsibility. Although the operation is carried out by surgeons, the hospital or medical facility is rather crucial in ensuring that the correct infrastructure, instruments, and training are in place to guarantee robotic surgery is safe and effective. Should an error arise during surgery resulting from a system malfunction, inadequate training, or robotic system maintenance, the hospital may be held liable. Maintaining robotic systems in excellent repair and ensuring they operate as expected is one major area hospitals might be held accountable for. Should a robotic system fail due to inadequate maintenance—such as not calibrating the system or replacing malfunctioning components—the hospital might be held liable for failing to ensure that equipment is in proper operating order. The hospital also has to make sure physicians are always acquiring fresh skills and improving their robotic system use. They should also know about the probable drawbacks and hazards of the technology. Should a surgeon error because to inadequate training or poor knowledge of the robotic technology, the hospital may be liable for not adequately preparing its medical personnel [14].

C. Liability of Robotic System Manufacturers

The section of the firm responsible for creating the robotic system in surgery adds even another degree of complication to the legal setting of who bears liability. Usually, faults in normal surgery fall on the surgeon or hospital. In robotic surgery, however, the manufacturer of the device might be held liable should design, manufacturing, or software flaws compromise operations during surgery. Laws mandate that manufacturers ensure their products satisfy criteria for quality and safety. Should they fail, they can find themselves sued for damages.

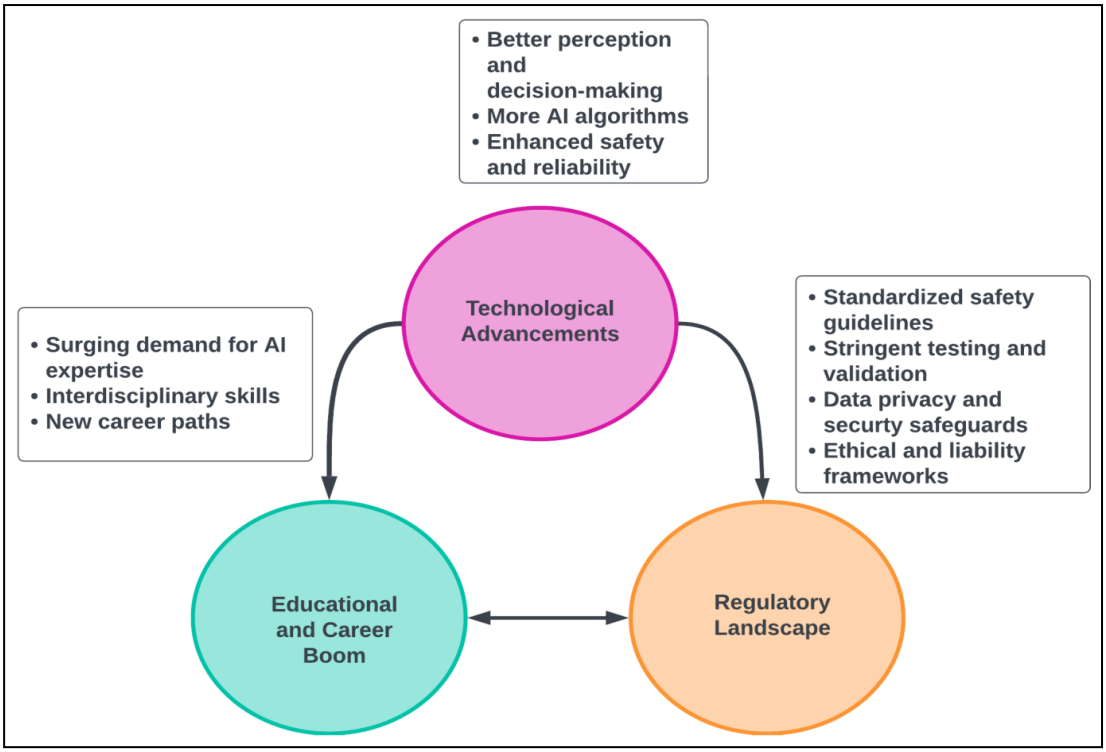

Figure 2: Liability of Robotic System with technological Avancement

So, if a robotic system fails during surgery because of a mistake in the design, like bad hardware or software, the company that made it could be held responsible for the harm it caused. If, say, a robotic arm breaks down and a mistake is made during surgery or a patient is hurt, the company that made the arm could be held responsible for not following standards for tool design. In the same way, the company that made the robotic system can be held responsible for any problems that happen during treatment if the software wasn't tested properly or had bugs that made it useless. The makers of these systems make sure they are used and maintained correctly by giving clear instructions, training materials, and expert help. If they don't meet these standards, they could be held responsible for any harm caused by mistakes or abuse because of bad lead- ship. As robots get better and AI is added to them, manufacturers are being held more accountable for the methods and decision-making processes they use. Depending on how they work, the creators and users of AI systems could be sued if they give customers bad advice or do things that hurt them. The people who make robotic systems have to make sure that their goods work well, can be trusted, and are safe. If mistakes happen during computer surgery, they could be sued for what they did in these places.

D. Informed Consent and the Patient's Understanding of Robotic Surgery

Informed consent is a key part of both medical ethics and the law. It makes sure that patients fully understand the risks, rewards, and other choices before agreeing to a treatment or operation. Because robotic equipment is so high-tech and comes with possible risks, informed consent is even more important in robotic surgery. Doctors and nurses must make sure patients understand both the general risks of surgery and the specific risks that come with robotic assistance, which may be different from the risks that come with normal operation.
Patients should be told that robotic systems have risks that aren't present with other technologies. It's possible for the technology to break down, the program to have bugs, or the surgeon to not know how to use it correctly. Patients should also be told how much computer technology will be used in the surgery. A lot of people who have surgery think that the computers run themselves, but the surgeon generally has direct power over them. The patient should be told how the system works, what the surgeon is responsible for, and any risks or restrictions that might come with using robotic technology. If someone has doubts about how involved the robot is, informed consent might not be as accepted. It could also lead to legal issues if the patient's needs are not met. On the written permission form, there should also be information about how knowledgeable and trained the surgeon is with artificial systems. If a surgeon isn't very good at using a certain type of computer technology, the patient should know about it because it could affect how well the surgery goes. If these parts are missing, patients could say they weren't given enough information to make an informed treatment choice. This could lead to claims of mistake or lack of informed permission.

4. CASE STUDIES OF ROBOTIC SURGERY MALPRACTICE

A. Detailed Analysis of Real-World Case Studies Involving Robotic Surgery Errors

Example 1: Surgical Error Due to Robotic System Malfunction

A mistake made during surgery with the da Vinci Surgical System One well-known case of bad robotic surgery is the prostatectomy. A problem with the robotic arm caused big problems in this case because it let the surgery hurt important blood vessels. Later, it was found that the issue was caused by a mistake in the software, which made the robotic arm not follow the surgeon's exact directions. The surgeon did the sensitive surgery with the help of advanced technology, but the robot's problem caused damage that will last for a long time. The patient had serious internal bleeding and needed many treatments to fix the damage. This made their healing take longer and their stay in the hospital longer. This case brought up important questions about the hospital and the manufacturer's roles in making sure that robotic equipment is maintained and calibrated. Even though the surgeon did everything that was suggested, the failure of the artificial arm was probably due to a design or software error in the system. The company that made the robot was partly to blame for what happened because the software hadn't been tested fully in all possible running environments. The hospital also found those responsible for the malfunctioning robotic system responsible because they failed to properly update and manage it. This event shows how important it is for robotic surgery systems to have constant checks and balances, such as technical repair and software changes, to keep them from breaking down and doing damage.

Example 2: Informed Consent Issues in Robotic Surgery Procedures

A robotic-assisted laparoscopic cholecystectomy was done on another patient. This is a surgery to remove the gallbladder that is done with the help of a robotic medical device. One problem that happened after the surgery was a hole in the bile duct, which led to an illness and required several follow-up operations. According to studies, the patient wasn't told all of the possible risks of robotic surgery, such as the chance that it might not work or the specific risks that come with the technology used. The surgeon had a basic permission form for surgery, but she didn't go into detail about the risks of using the robotic system or how it would be used. A lawsuit was filed against the doctor and the hospital for not having proper informed consent. The court said that the patient wasn't given enough information about the differences between regular laparoscopic surgery and robotic-assisted surgery. As a result, he didn't fully understand the risks that come with using modern technology. The hospital was also to blame because they didn't make sure the informed consent process was thorough enough to take into account how complicated the surgery was technically. The main point of the malpractice case was that the computer system's participation and the specific risks that came from running it weren't properly disclosed.

This is a clear example of how quickly and completely better informed consent systems are needed in robotic surgery. Patients need to be told about both the general risks of surgery and the specific risks of using robots. For example, there is a chance that the robotic system could break down or that the doctor could put limits on how it can be used. Even when using high-tech tools like robotic surgery, this event tells us that responsible medical practice is mostly based on good communication and teaching patients the right things.

B. Lessons Learned from These Cases

These cases give us a new way to look at how complicated robotic surgery malpractice is and how important it is to make strong systems to protect patients and stop mistakes. The main thing we can learn from Example 1 is that when technology is used in surgery, it's important to have both skilled doctors and robotic systems that are easy to use and reliable. Hospitals and other medical facilities need to do regular repair, testing, and software changes on their robotic systems to make sure they work properly. Surgeons should be aware of the different problems and limits of these systems. Also, manufacturers need to make sure that their products work in all possible situations so that they don't break down during important activities. It is clear from this event that when robotic equipment breaks down, the maker, the hospital, and the operator are all responsible. Errors like these are less likely to happen when repair and system management are better organised. This protects patients' health.

As shown in Example 2, the information learnt is about the need for full informed consent in robotic surgery. Informed consent is a basic law and moral concept in healthcare. It becomes even more important when new technologies like computer systems are used. Patients must be fully told about both the process and the use of the robot, as well as the risks that come with robotic technology and the likely outcomes of its use. Surgeons and hospitals need to make sure that the process for getting informed consent is complete, easy to understand, and fits the needs of the robotic-assisted surgery. This case shows that doctors need to be honest with their patients about new technology and make sure they understand what they are agreeing to, because not doing so could put them at legal risk. Both cases show how responsibility is changing in robotic surgery and how better law systems are needed to handle the duties of makers, hospitals, and doctors to make sure results are effective and safe. They also stress how important it is to be proactive about managing risks, which includes keeping robotic equipment in good shape and teaching patients more so that accidents happen less often and patient rights are protected.

5. PROPOSALS FOR REFORMING LEGAL FRAMEWORKS

A. Analysis of Current Gaps in Liability Law and Potential Reforms

The current rules on responsibility have not kept up with the fast progress in medical technology, especially when it comes to robotic surgery. Normal malpractice rules don't take into account how complicated robotic systems are, so they usually blame the doctor or the organisation for surgery mistakes. Even though robotic surgery involves machines, the surgeon is still in charge of the process. However, the use of machines adds new causes of failure, such as software errors, problems with the robotic system, and the maker and healthcare institution's duties in system upkeep and training. Because of this, it is hard for current liability systems to exactly figure out who is responsible when mistakes happen during computer activities. One of the biggest problems with the current liability rules is that they don't make it clear what producers are responsible for when something goes wrong. Robotic surgical system makers often say that mistakes in surgery can't be blamed on the system itself because the surgeon is controlling it. Still, manufacturers may be responsible for not making sure the technology is safe and reliable when systems fail or software bugs show up. Furthermore, hospitals and other medical facilities are in a tough spot because there aren't many law examples that show them how to properly maintain and run robotic technology. Reforms that make it easier for all robotic surgery users to share jobs will help to close these gaps.

B. Recommendations for Clearer Guidelines on Surgeon, Hospital, and Manufacturer Liability

Because responsibility in robotic-assisted treatments is so complicated, we need a clear and complete legal framework. Changing liability law starts with making it clear what each party is responsible for, including doctors, hospitals, and makers, through clear rules. Surgeons should only be able to use robotic systems after getting the right training and licensing. This would show that they are skilled. Following the right training and procedures, along with their ability to handle the risks that come with robotic surgery, should help figure out who is responsible. Maintenance and testing of robotic systems are also the job of other healthcare facilities, such as hospitals. Robotic equipment works safely, so there should be a clear rule that it needs to be inspected, tested, and maintained on a frequent basis. Also, hospitals need to make sure that everyone on the team knows how to use the robotic system and spot any problems before they get worse.

C. The Need for Updated Informed Consent Processes that Reflect the Complexities of Robotic-Assisted Surgeries

Informed permission, which is a basic principle of medical ethics, needs to be changed to fit the needs of robotic surgery. In traditional informed consent systems, the risks and rewards of a surgery are usually explained. These systems do not work well with robotic surgery. Patients need to know what the robotic system is used for during their surgery, especially about the process, possible risks, and other problems that are unique to robotic-assisted surgeries. Surgeons should make it clear that even though the robot may improve accuracy, the technology could break down. This is why the surgeon's skill is so important.

Changes need to be made to consent forms so that they fully explain the role of the robotic system and the chances of mistakes from both human and machine parts. This will make sure that patients fully understand the risks. It's also very important to let people ask questions and get explanations that help them understand. This will help people make better choices and make it less likely that there will be arguments about approval if problems arise. Also, the surgeon's experience with robotic surgery should be brought up during the informed consent process because it will affect how well the surgery goes. Comprehensive informed consent makes sure that patients fully understand the surgery they are going to have. This protects both their rights and the healthcare practitioner's legal situation.

D. Potential for Developing Specialized Legal Frameworks for Emerging Medical Technologies like Robotic Surgery

The quick development of medical tools like robotic surgery means that new laws need to be made to keep up with these changes. The rules we have now were mostly made to deal with old-fashioned medical methods, which aren't always enough to handle the problems that modern technology brings up. By giving new medical technologies, like robotic surgery, their own legal categories, specialised systems would make sure that responsibility issues are clearly stated and that they are properly watched. These kinds of law models should include clear rules for testing and licensing, setting a standard for how robotic systems should be used to protect patients. These models should also include the specific risks that come with putting artificial intelligence and self-driving technologies into medical systems. For example, software bugs or algorithms that can't make the best surgery choices should be taken into account. Setting up a governing group whose sole job is to make and use new medical technologies could also help make sure that they meet agreed-upon safety standards, which would then guide the growth of these systems. Also, the systems in these specialist models should be able to change as new technology and surgery methods come out. This ability to change is needed to keep the law clear and protect people in a healthcare system that is changing quickly. A governing framework that looks to the future for new technologies would not only make patients safer, but it would also make things clearer for everyone involved in robotic processes, which would boost trust and responsibility in the use of this high-tech medical gear.

6. CONCLUSION

Because it can be used more accurately, cause less harm to patients, and get better results, robotic surgery has permanently changed the field of medicine. Still, it brings up some moral and legal issues, especially when it comes to duty. There have been rules about who is responsible for medical malpractice in surgery for a long time. Still, these rules aren't nearly enough to deal with the new problems that robotic technologies bring up. There are surgeons, hospitals, and companies that make robotic systems involved. However, it gets harder to figure out who is to blame when problems or mistakes happen during robotic-assisted surgeries. Case studies have shown important law issues, such as how hard it is to figure out who is responsible when a computer system fails or when a doctor's qualifications are called into question. Also, problems with the informed consent process have shown that patients need to know more about the benefits and risks of robotic systems used in surgery. These events show how badly we need better rules to make people responsible and protect patients right away. There are many ideas in this paper for how to solve these issues, such as making it easier to hold operators, hospitals, or manufacturers accountable, and making sure that new medical tools meet certain legal requirements. Making sure that informed consent methods are up-to-date and include the risks of robotic surgery is also important for keeping patients' freedom and trust. As robotic surgery gets better, rules should change to make sure that everyone who uses robots in surgery is responsible for their parts. Clear rules that protect patients and let doctors do difficult procedures like robotic surgery would help them do less work. This means that healthcare services will generally get safer and better after this.

REFERENCES

[1] Abbasi Habashi, S.; Koyuncu, M.; Alizadehsani, R. A Survey of COVID-19 Diagnosis Using Routine Blood Tests with the Aid of Artificial Intelligence Techniques. Diagnostics 2023, 13, 1749.

[2] Alhazmi, A.K.; Alanazi, M.A.; Alshehry, A.H.; Alshahry, S.M.; Jaszek, J.; Djukic, C.; Brown, A.; Jackson, K.; Chodavarapu, V.P. Intelligent Millimeter-Wave System for Human Activity Monitoring for Telemedicine. Sensors 2024, 24, 268.

[3] Almasoud, A.S.; Mengash, H.A.; Eltahir, M.M.; Almalki, N.S.; Alnfiai, M.M.; Salama, A.S. Automated Arrhythmia Classification Using Farmland Fertility Algorithm with Hybrid Deep Learning Model on Internet of Things Environment. Sensors 2023, 23, 8265.

[4] Bhakar, S.; Sinwar, D.; Pradhan, N.; Dhaka, V.S.; Cherrez-Ojeda, I.; Parveen, A.; Hassan, M.U. Computational Intelligence-Based Disease Severity Identification: A Review of Multidisciplinary Domains. Diagnostics 2023, 13, 1212.

[5] Caggiari, S.; Jiang, L.; Filingeri, D.; Worsley, P. Optimization of Spatial and Temporal Configuration of a Pressure Sensing Array to Predict Posture and Mobility in Lying. Sensors 2023, 23, 6872.

[6] Oberije, C.J.G.; Sharma, N.; James, J.J.; Ng, A.Y.; Nash, J.; Kecskemethy, P.D. Comparing Prognostic Factors of Cancers Identified by Artificial Intelligence (AI) and Human Readers in Breast Cancer Screening. Cancers 2023, 15, 3069.

[7] Khosravi, P.; Schweitzer, M. Artificial Intelligence in Neuroradiology: A Scoping Review of Some Ethical Challenges. Front. Radiol. 2023, 3, 1149461.

[8] Bellini, V.; Brambilla, M.; Bignami, E. Wearable Devices for Postoperative Monitoring in Surgical Ward and the Chain of Liability. J. Anesth. Analg. Crit. Care 2024, 4, 19.

[9] Wu, X.; Wu, Y.; Tu, Z.; Cao, Z.; Xu, M.; Xiang, Y.; Lin, D.; Jin, L.; Zhao, L.; Zhang, Y.; et al. Cost-Effectiveness and Cost-Utility of a Digital Technology-Driven Hierarchical Healthcare Screening Pattern in China. Nat. Commun. 2024, 15, 3650.

[10] Mohan, A.; Wara, U.U.; Shaikh, M.T.A.; Rahman, R.M.; Zaidi, Z.A. Telesurgery and Robotics: An Improved and Efficient Era. Cureus 2021, 13, e14124.

[11] Barba, P.; Stramiello, J.; Funk, E.K.; Richter, F.; Yip, M.C.; Orosco, R.K. Remote telesurgery in humans: A systematic review. Surg. Endosc. 2022, 36, 2771–2777.

[12] Acemoglu, A.; Krieglstein, J.; Caldwell, D.G.; Mora, F.; Guastini, L.; Trimarchi, M.; Vinciguerra, A.; Carobbio, A.L.C.; Hysenbelli, J.; Delsanto, M.; et al. 5G Robotic Telesurgery: Remote Transoral Laser Microsurgeries on a Cadaver. IEEE Trans. Med. Robot. Bionics 2020, 2, 511–518.

[13] Li, J.; Yang, X.; Chu, G.; Feng, W.; Ding, X.; Yin, X.; Zhang, L.; Lv, W.; Ma, L.; Sun, L.; et al. Application of Improved Robot-assisted Laparoscopic Telesurgery with 5G Technology in Urology. Eur. Urol. 2023, 83, 41–44.

[14] Kutana, S.; Bitner, D.P.; Addison, P.; Chung, P.J.; Talamini, M.A.; Filicori, F. Objective assessment of robotic surgical skills: Review of literature and future directions. Surg. Endosc. 2022, 36, 3698–3707.