



Robotic mitral valve repair in Japan and keyhole cardiac surgery in NewHeart Watanabe Institute

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Robotic cardiac surgery in Japan

It has been a long road to the insurance coverage of robotic cardiac surgery in Japan since the application of the first generation of the da Vinci surgical system (da Vinci, Intuitive Surgical, Inc., Sunnyvale, CA). After six years of manufacturer's clinical trials at Kanazawa University (1-4), where we were previously based, and the National Cerebral and Cardiovascular Center, the pharmaceutical affairs department approved the da Vinci S system in December 2015.

In 2018, national insurance coverage was approved for robotic valve repair, and at the same time, the Japanese Association for Thoracic Surgery, the Japanese Society for Cardiovascular Surgery, and the Japan Robotic Surgery Society collaborated to establish the Robotic Assisted Surgery Council to accredit facilities and surgeons, and provide education for the safe use of robotic surgery. The council has, so far, approved permits for 25 facilities to perform robotic cardiac surgeries. The number of cases has also increased rapidly since 2018 and has been increasing annually. In 2021, more than 700 robotic cardiac surgeries were performed, including more than 600 mitral valve repairs.

Keyhole cardiac surgery at NewHeart Watanabe Institute

In robotic surgery via a small thoracotomy, which is the mainstream approach internationally, the surgeon approaches the surgical site via the MICS (minimally

invasive cardiac surgery) wound and performs robotic intracardiac maneuvers. Using this approach, the advantages of robotic surgery, such as observation and manipulation of the subvalvular apparatus, can be enjoyed to some extent. However, once the operator is experienced, the final goal should be to change direction and perform totally endoscopic surgery. We have been performing totally endoscopic surgery using only ports since its introduction, because we believe that we should aim for less invasive surgery than MICS. Since this is the least invasive method for the patient, use of the robot for totally endoscopic surgery seems completely logical.

Our team has performed over 1,200 robotic cardiac surgeries so far. Robotic surgery for structural heart diseases, such as mitral regurgitation, is performed via only four ports, which is called keyhole cardiac surgery. In 2021, we performed 195 robotic cardiac surgeries, of which 180 were related to mitral regurgitation. In addition, we are making efforts to reduce the operation time, cardiopulmonary bypass time and aortic clamp time by adding several innovations (5-8). Currently, the first choice for valve repair is chordae reconstruction using the loop technique, followed by resection and suture or augmentation using autologous pericardium, depending on the case. Annuloplasty is performed with continuous mattress sutures (9). Standard mitral repair is completed with operative, cardiopulmonary bypass, and aortic clamp times of 120, 90, and 60 min, respectively, and no blood products are used. The following concomitant procedures can also be performed via the same ports: tricuspid

annuloplasty, MAZE procedure with cryoablation, left atrial appendage closure, and so on (10).

Future prospects in Japan

Currently, robotic surgery for repair of atrial septal defects and valve replacement are technically feasible, although national insurance restrictions prevent their aggressive use. Future insurance coverage is expected for valve replacement, atrial septal defect closure, and cardiac tumor resection. All these procedures avoid median sternotomy and thoracotomy and reduce unnecessary chest wall injury, thus contributing to reduced complications, avoidance of blood transfusions, early discharge from the hospital, and early return to society, which in turn leads to reduced medical costs.

Currently, only the da Vinci is approved for valve plasty among cardiac surgical procedures in Japan. Meanwhile, in the field of urology, the use of the Hinotori Surgical Support Robot System (Medicaroid, Japan), a domestically produced robot, has also been approved. The Hinotori is similar in concept to the da Vinci S and Si system, but its advanced Japanese technologies, such as eight-axis operation arms and pivot setting, full high-vision 3D system and so on. It is possible that the Hinotori might be approved for use in cardiac surgery in the future, and we also look forward to the use of robots with Japanese technology.

Conclusions

In Japan, robotic surgery is expected to continue to develop with a focus on mitral valve repair.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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