Use of a new device for distal coronary anastomosis -pig model-

Yoshifumi Itoda, Panthee Nirmal, Takehiro Ando, Ichiro Sakuma, and Minoru Ono

Abstract— OBJECTIVE: Different devices have been developed for distal coronary anastomosis for minimally invasive coronary artery bypass surgery. But none of these devices have been universally adopted. In this study, we describe the safety and efficacy of a new anastomotic device that we developed using swine coronary bypass model. METHODS: The device enables us to skip manual ligation with easy pinching motion after conventional suturing. Five miniature pigs were used for this study. Bilateral internal thoracic arteries were harvested and anastomosed to right coronary artery and left descending artery, respectively using new device (n=4), and conventional mono propylene suture (n=1). After 1 month of operation, pigs were sacrificed and evaluated. RESULTS: Suture time measured during surgery revealed no significant difference between device group and conventional sample. Angiography after 1 month showed good patency (FitzGibbon A). Pathological findings revealed no specific inflammatory change around devices and surrounding tissues. CONCLUSION: The device we developed was feasible for distal coronary anastomosis in present swine model.

I. HEADINGS

In recent years, robotically assisted surgery has been introduced to cardiovascular surgery as a minimally invasive procedure. But it was pointed out that there were several obstacles to apply robotics to coronary artery bypass. Main points of these problems include difficulty to perform a running suture and tying without tactile feedback in limited space. In previous reports, different devices including various adhesives and one shot type systems for coronary distal anastomosis. But none of them have been universally adopted for some reasons; patency, handling, indication, and costs. We developed the new device which has feasibility for minimally invasive surgery followed by robotic surgery for coronary distal anastomosis. In this report, its effectiveness and safety was evaluated using swine coronary bypass model.

II. METHODS AND MATERIALS

The device was designed simply with biocompatible stain-less steel combined to the free end of the ordinary mono-propylene suture (figure 1). The device enables us to skip manual ligation with easy pinching motion after conventional suturing. Five healthy male pigs (Crown miniature pig, 25-30kg) were used in this study. Under general anesthesia, chest was opened and left internal thoracic artery (LITA) and right internal thoracic artery (RITA) were harvested in skeletonized fashion. Heart was stabilized with heart positioner and left descending coronary artery (LAD) and right coronary artery (RCA) were dissected. Using coronary shunt and retractor tape, coronary anastomoses were done (LITA to LAD, RITA to RCA, respectively). New device were used in four of five pigs. Conventional mono propylene suture was used in the remain. After the operation, 100mg of oral aspirin was administered for one month and finally pigs were sacrificed and anastomoses were evaluated by following way. (1) Suture time was measured during operation. (2) Angiography was done using C-arm X-ray system after 1 month of operation. (3) Anastomotic sites were resected and histologically examined about inflammatory change.

RESULTS

(1) Suture time using new device was 16.75 min. and 18.25 min. in LITA-LAD and RITA-RCA respectively. This time was as equal as conventional sample (18 min. and 24 min.).

(2) Angiography after 1 month of operation revealed FitzGibbon A (without stenosis up to 50%) in all anastomoses. No evidences of parse-string suture and device specific stenosis were shown (figure 2).

(3) Pathological study showed general inflammatory response including cell filtration, fibrosis and neointimal hyperplasia. But there were no specific change by using new devices; invasiveness to vessels and surrounding tissues (figure 3).

CONCLUSION

It was confirmed that the device we developed has feasibility to use in coronary artery bypass surgery in this mid-term chronic study. Now we are challenging more long period model. Evaluating efficacy of this devise in closed or limited operative space, further research is necessary.