The THAI Journal of SURGERY 2014;35:130-133.
Official Publication of the Royal College of Surgeons of Thailand

Original Article

"Sawanpracharak" Connector: A Single Tube Intercostal Drainage Connector

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Abstract

Background: **Intercostal drainage (ICD) is categorized as a minor operation. The system used to drain content may be either single or double bottle system. The problem of a single bottle system occurs when the content is above the water level. In a double bottle system, if the patient takes very deep breath, the water may be siphoned from water-seal bottle into reservoir bottle and causes open pneumothorax.**

Objective: **To present an ICD connector that can prevent the problem of both single and double bottle systems.**

Materials and Method: **The "Sawanpracharak" (SPR) connector was designed with the concept that if the draining tube could be adjusted up to keep the lower end at 2 cm below water all the time, it could correct the problem of a single bottle system. At the same time, it could remove the reservoir bottle and hence, correct the problem of a double-bottle system.**

Result: **The SPR connector was designed, invented and had been applied to patients with pneumo/hemothorax and parapneumonic effusion. It could drain the pleural content easily and comfortably. No problem of the two systems is found with this connector.**

Conclusion: **The SPR connector is a new instrument which can solve the problem of both single- and double-bottle systems.**

Keywords: **Intercostal tube, chest tube connector**

Introduction

Intercostal drainage is a common procedure in surgical practice but also a life-saving procedure, especially in trauma[1,2]. For pneumo-hemothorax, if a single-bottle system is used, the blood drained from pleural cavity will raise water level and result in difficult subsequent drainage. If a double bottle system is applied, the reservoir bottle collects the content and makes water level of water-seal bottle undisturbed. The latter system, however, has some other problems. When the patient breathes heavily i.e. patient with hypoxia or head injury, the high negative pressure will reflux the water from water-seal bottle into reservoir bottle and cause open pneumothorax (Figure 1). Moreover, the size of the chest tube and the size of the draining tube of the conventional connector are very different and, when connected together, can cause "bottle neck" effect (Figure 2). The drainage is filled up and finally clogged. Due to these problems, the Sawanpracharak (SPR) connector was designed and invented to overcome the problems.

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Figure 1 Problem of single bottle and double bottle system

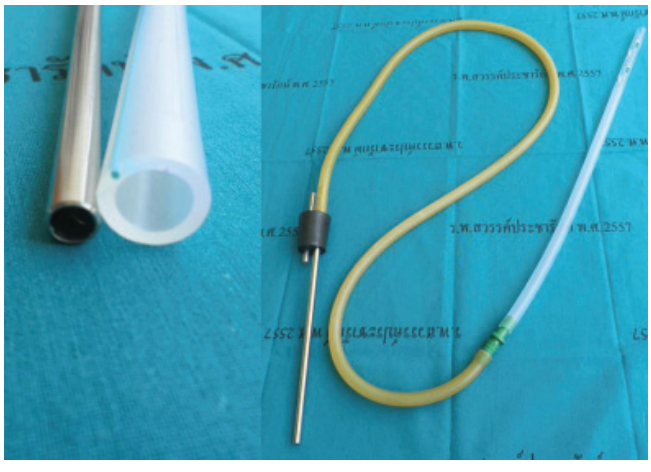

Figure 2 Size of draining tube of conventional connector and chest tube Fr 32

Figure 3 SPR tube and SPR cap

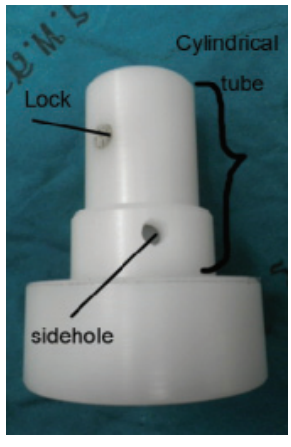

Figure 4 SPR cap

Figure 5 Size of conventional draining tube and SPR tube

Figure 6 Marker level at 2 and 4 cm

Materials and Methods

The SPR connector composed of two parts, the SPRcap and the SPR tube (Figure 3). The cap was designed as a screwcap with a cylindrical tube in the center. The cylindrical tube was used as the passage of SPR tube. There were four small side holes around it, connecting its lumen to the outside atmosphere (Figure 4). There was a lock above the side holes, used to fix the SPR tube. The SPR tube was an extra large tube with a diameter of nearly 10 mm, much larger than conventional draining tube (Figure 5). At both distal ends, there were markers to indicate its depth (Figure 6). The connecting apparatus that used to connect

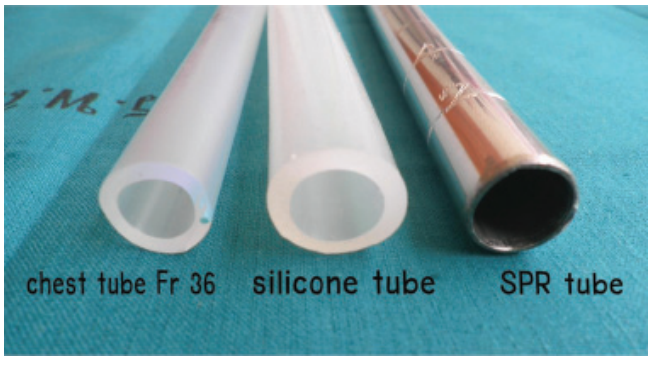

Figure 7 Compared size between chest tube, silicone tube and SPR tube

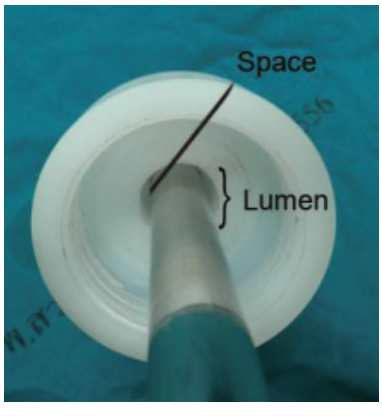

Figure 8 The space between the lumen of cylindrical tube and SPR tube

Figure 9 Airflow from the bottle through the space and side holes

between chest tube and SPR tube was a large silicone tube. Its diameter was about 10 mm, large enough to wear on both chest tube and SPR tube (Figure 7), preventing the bottle neck phenomenon.

To compose the apparatus, the SPR tube is inserted into the cylindrical tube of the SPR cap, with a space between the lumen of cylindrical tube and SPR tube. This space is used as an exit of air (from the pleural cavity), through the side holes and out of the bottle (Figure 8, 9). The SPR cap is screw locked to the bottle. The lower tip of SPR tube is adjusted at 2 cm below the water level (Figure 10). Once the content increases the water level, the SPR tube is unlocked, pulled up and kept at the 2-cm underwater level. To test for small pneumothorax, clamp the silicone tube, unlock the SPR tube and pull it up to just under the water level and lock, then unclamp the silicone tube and ask the patient to cough and look for the bubble to emerge.

Figure 10 Complete set of SPR connector no 'bottle neck' junction

Figure 11 Applied to hemothorax patient

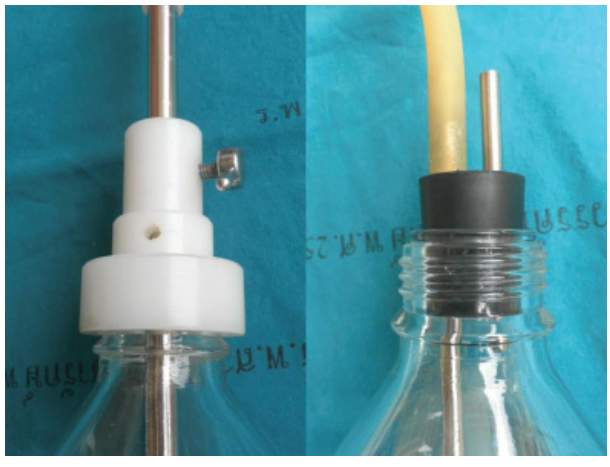

Figure 12 Secure locked and unsecure locked

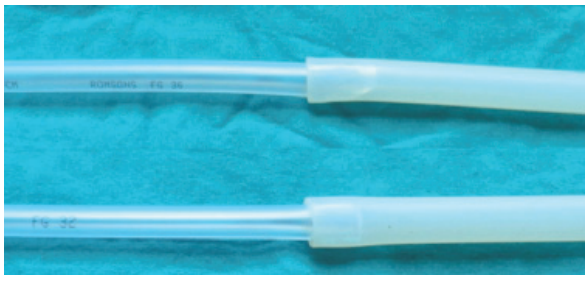

Figure 13 Chest tube Fr 36,32 and silicone tube

Results

Initially SPR connector had been applied to 10 patients with pneumohemothorax. Later it had been applied to patients with parapneumonic effusion. In hemothorax case, the large tube of the system could evacuate the blood rapidly by the gravity force, no tube stripping is required (Figure 11). In patients with parapneumonic effusion, although the content is thick but the large draining tube could remove the content conveniently and no clogging is found.

Discussion

The SPR connector had many advantages over the conventional connector. When compared to single bottle system, it could drain the content much more freely without concerning the water level. Although the connector was designed to use with one bottle but it could function as double bottles. The 'two in one bottle' could receive some amount of content and could prevent the siphon phenomenon at the same time. With one bottle, it is more comfortable to carry than double bottles. With adjustable tube, it can check the minimal air leakage while conventional connector cannot.

Another problem of conventional connector is the size of draining tube which was too small. When the large sized chest tube was inserted in the pleural cavity attached to the smaller tube adaptor and smaller draining tube, it would create multiple bottle neck junctions. The inadequate drainage may result in clotted hemothorax and later fibrothorax which was a serious complication and the patient may need a thoracotomy to remove the lesion. Chest tube stripping did not show any clear benefit in enhancing chest tube patency but may significantly increase negative intra-thoracic pressure that could cause harm (eg, tissue entrapment, increased bleeding) to the patient[3]. By merging the air vent tube and the draining of conventional connector into a (single) SPR tube, this extra-large tube helped improve the drainage considerably. SPR tube was designed to a comparable size of Fr 32, 36 chest tubes which were commonly used in surgical practice (Figure 13). With its single tube design, it could also prevent a misconnection between chest tube and air vent tube of conventional connector.

The locking system of SPR connector was designed as screw cap, differed from conventional connector which was designed as plug (Figure 12). More security when it is locked to the bottle and much easier to handle and carry.

Conclusion

The SPR connector is an innovation that could correct the problem of both conventional single and double bottle systems. For the patient, it is a safe instrument. For the practitioner, it is easy to apply, monitor, handle and care.

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