

# การผ่าตัดรักษา Patent Ductus Arteriosus ด้วยเทคนิคที่ใช้ทั้งการผูกและหนีบหลอดเลือด

สมชาย ไวกิตติพงษ์

## Surgical Treatment of Patent Ductus Arteriosus by Combined Ligation and Clipping

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### บทคัดย่อ:

**บทนำ:** ปัจจุบันการรักษาโรค Patent ductus arteriosus (PDA) สามารถทำได้หลายวิธี วิธีที่ถูกเลือกมาใช้ควรจะเป็นวิธีที่ปลอดภัย มีโอกาสเกิดภาวะแทรกซ้อนน้อย ไม่เสียค่าใช้จ่ายมากเกินไป และช่วยลดระยะเวลาการอยู่โรงพยาบาลได้

**วัตถุประสงค์:** เพื่อประเมินผลการผ่าตัดรักษา PDA ด้วยเทคนิคที่ใช้ทั้งการผูกและหนีบหลอดเลือด

**วัสดุและวิธีการ:** ตั้งแต่วันที่ 1 มกราคม พ.ศ. 2544 ถึงตุลาคม พ.ศ. 2553 มีผู้ป่วย PDA ได้รับการผ่าตัดรักษาด้วยเทคนิคนี้ 112 ราย การผ่าตัดจะทำผ่านการเปิดแผลขนาดเล็กเข้าช่องทรวงอกข้างซ้ายและผูกหลอดเลือด PDA ด้วยไหมขนาดใหญ่ 2 ครั้ง หลังจากนั้นจะหนีบหลอดเลือด PDA ด้วยที่หนีบโลหะอีก 1 ครั้ง ผู้ป่วยส่วนใหญ่จะกลับบ้านได้ภายใน 1-2 วันหลังผ่าตัด และจากการตรวจติดตามไม่พบมีการปิดไม่หมดของ PDA

**สรุป:** วิธีการผ่าตัดรักษา PDA ด้วยเทคนิคที่ใช้ทั้งการผูกและหนีบหลอดเลือดมีความปลอดภัยและได้ผลดี โดยเฉพาะในผู้ป่วยเด็ก

**คำสำคัญ:** โรคหัวใจพิการแต่กำเนิดชนิดหลอดเลือดเกิน

### Abstract:

**Introduction:** At present there are many alternative treatments for closure of patent ductus arteriosus (PDA). The preferred technique should be safe and effective in terms of morbidity, mortality, cost, and length of hospital stay.

**Objective:** To assess the surgical treatment outcome of patent ductus arteriosus by combined ligation and clipping technique.

**Materials and methods:** From December 2001 to October 2010, 112 patients with isolated PDA were treated by this technique. Through left mini-thoracotomy, the ductus was simple double ligated with heavy silk and also clipped with one titanium clip. Usually, the patients could be discharged home within one or two days of the operation.

**Results:** There was no death or serious post-operative complication. There was no residual shunt on follow up.

**Conclusions:** Combined ligation and clipping was safe and effective for treatment of PDA, especially in infants and children.

**Key words:** patent ductus arteriosus

## Introduction

Surgical treatment of patent ductus arteriosus (PDA) was first successfully performed by Gross and Hubbard in 1938.<sup>1</sup> In the past, complete division and suture was the standard surgical treatment of choice.<sup>2</sup> Subsequently, however, various surgical techniques have been developed, such as: simple ligation, clipping, or video-assisted thoracoscopic clipping. These techniques aimed to make the operation safer and shorten hospital stay, but the drawback of them was the possibility of recanalization or incomplete occlusion of the duct.

We report here our technique with combined ligation and clipping. Our aim was to assess the surgical outcome of this technique in terms of the safety and effectiveness.

## Materials and methods

From December 2001 to October 2010, 112 patients with isolated PDA had PDA

closure by this technique. We excluded premature infants or patients who needed ventilator in the pre-operation period. The diagnosis of PDA was confirmed by colour Doppler echocardiography. We used this technique for all children. For adult patients, we used this technique only for small ductus without pulmonary hypertension, usually not more than 5 mm. in diameter.

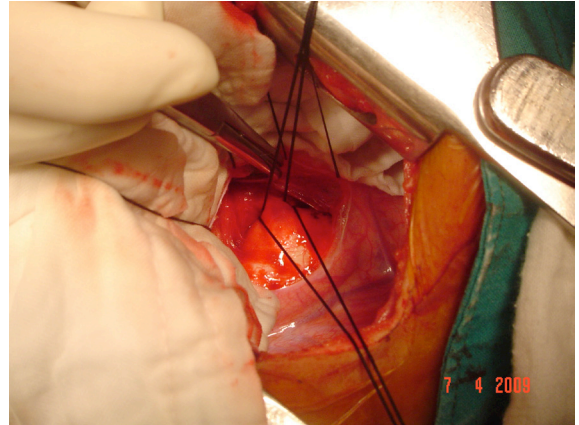
The procedure was performed under general anesthesia and through a left thoracotomy. We used the mini-thoracotomy, small incision just behind the scapula (Figure 1). The Serratus Anterior muscle was preserved and Latissimus Dorsi muscle was only partially cut to enter the chest through 4<sup>th</sup> intercostal space. Lung was retracted with stay sutures to expose the ductus. The ductus was identified, dissected, and isolated. Interruption of ductal flow was performed by simple double ligation with heavy black silk number two (Figure 2), then a large

titanium clip (Ligaclip® LT 400, Ethicon Endo-Surgery Inc., made in USA) was placed at the pulmonary end avoiding injury to the recurrent laryngeal nerve below the ductus (Figure 3), to give complete interruption of the duct. The chest tube was removed in the operating room after the skin was closed. The patient was extubated in the operating room, allowed to recover, and returned to the ward. Usually he or she could be discharged within one or two days of the operation. After discharge, the patients would be followed up at least two months at the out-patient clinic. On follow up, if there was still abnormal murmur, a colour flow echocardiography would be performed to identify residual flow across closed arterial duct.

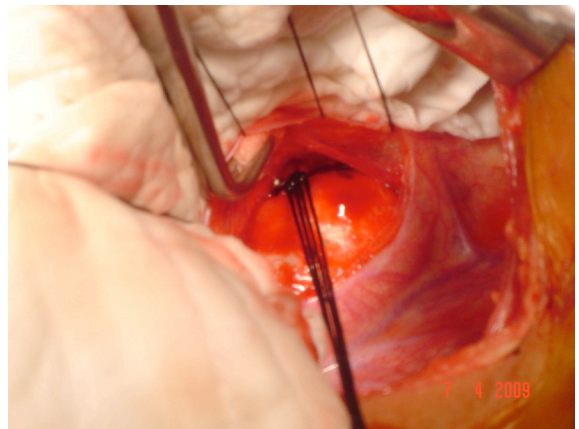
The data are expressed as mean, range and percentage where appropriate.



**Figure 1** Post-operative photograph showed small incision for posterolateral mini-thoracotomy



**Figure 2** Intraoperative photograph showed the ductus was dissected and isolated with two heavy silk through left mini-thoracotomy



**Figure 3** Intraoperative photograph showed the ductus interrupted with both ligation and clipping

## Results

There was 27 males and 85 females. Mean age was 8.6 years (range, 4 months to 49 years) (Figure 4). Mean weight was 18.5 kg (range, 3.2 to 72 kg) (Figure 5). There was no death

or serious complication. There was no post-operative bleeding or pneumothorax. There was

no recurrent laryngeal nerve injury or residual shunt on follow up.

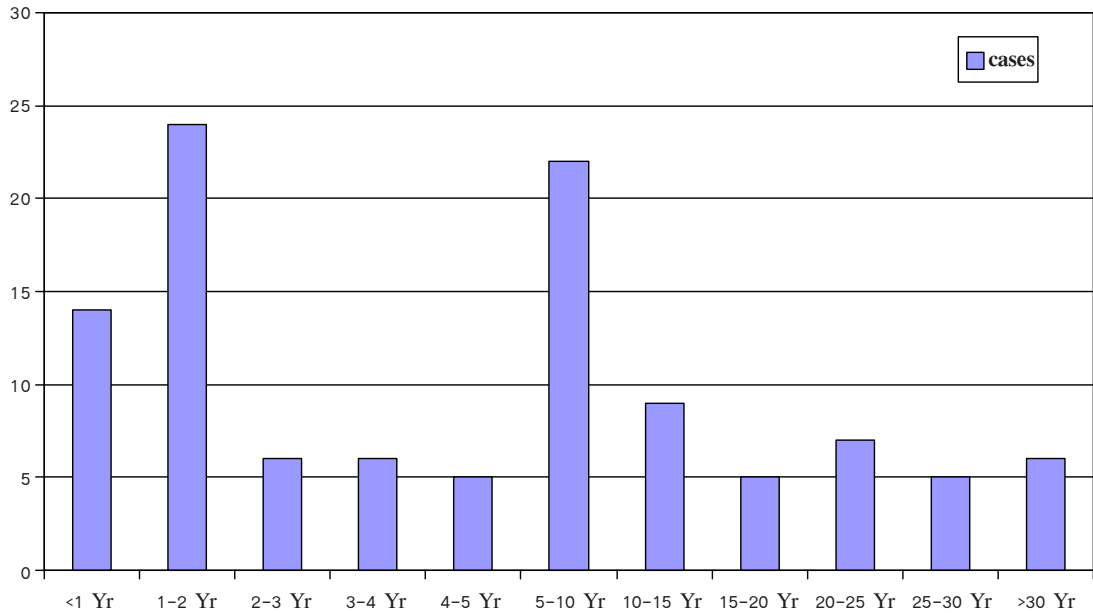


Figure 4 Age distributions of the patients

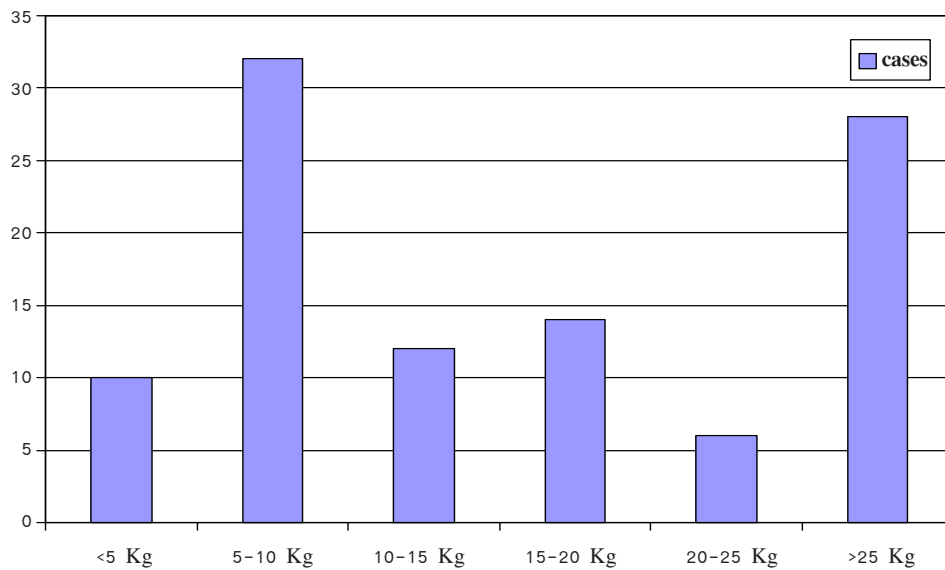


Figure 5 Body weight distributions of the patients

## Discussions

The goal of treatment for PDA is closure or interruption of the ductus. Since 1939, surgical closure of the PDA has been the “gold standard” treatment.<sup>1,2</sup> At present, although there are many alternative treatments for closure of PDA such as percutaneous transcatheter approach or video-assisted thoracoscopic approach, transthoracic surgical approach still plays an important role for treatment of PDA.

The major goal of other alternative treatments has clearly been to avoid surgery and its rare but significant attendant risks. For transcatheter techniques, although they have been effective, each has had problems related either to the length of procedure (and prolonged fluoroscopy times), large delivery systems (and potential risks to the femoral veins and arteries), creation of gradients to the left pulmonary artery, and, perhaps most importantly, residual leaks. There was also some concern about their cost when compared with surgical closure.<sup>3-5</sup> Gray et al.<sup>3</sup> in a retrospective cohort study, which compared clinical outcome and costs between surgical closure and transcatheter closure using Rashkind PDA occluder, concluded that surgical closure was more effective and less costly. From their studies, transcatheter closure resulted in 87.6% success rate and 2.7% major complications compared with 100% success rate and 0.2% major complications in the surgical group. Hawkins et al.<sup>4</sup> demonstrated similar cost, but higher effectiveness rate in a surgical ligation group than in a transcatheter coil occlusion group. But the patients in their study were not randomized and rather few in number. However, Pass et al.<sup>6</sup>

demonstrated better results with new amplatzer ductal occluder, with 89% occlusion rate on post-catheterization day 1 and 99.7% at one year. However, their patients were somewhat young, median age was 1.8 years and mean weight 11 kg.

Another new less invasive technique for surgical closure is video-assisted thoracoscopic clipping.<sup>7-10</sup> Although the results from the literature looked so promising, there are still many technical aspects of concern.

For surgical closure, there also has been continued development to improve clinical outcome, to be less invasive and reduce hospital stay. In the past, most surgeons advocated division and suture as surgical treatment of choice, which was an absolutely effective procedure with no residual shunt.<sup>2,11</sup> However, this technique in itself carried some potentially dreadful risks, with massive bleeding difficult to control during the operation. More simple procedures such as ligation or clipping are safer but may produce incomplete interruption which results in residual shunt.<sup>12-14</sup> Rate of residual shunt after surgical ligation from these reports ranged from 3% to 6% (Table 1).

To give more certainty for complete interruption of ductus flow, we supplemented double ligation with clipping. We believe this procedure is safer and can decrease the rate of residual shunt. Our latest results of 112 patients with combined ligation and clipping technique through mini-posterolateral thoracotomy were satisfactory and comparable with other reports. Nonetheless, the approach for adult patients with large ductus or pulmonary hypertension is different. Usually, it is more harmful and involves higher risk. In this situation other techniques, rather than

**Table 1** Previous published studies of PDA closure by only Ligation technique

Authors	Year	No. of patients	Mortality	Residual shunt
Panagopoulos <sup>12</sup>	1971	739	4 (0.5%)	4 (0.5%)
Trippestad <sup>13</sup>	1972	673	6 (0.9%)	20 (3%)
Galal <sup>14</sup>	1977	144	3 (2%)	9 (6%)

surgical ligation, should be considered. A more favorable alternative surgical approach is closure under cardiopulmonary bypass.<sup>15,16</sup>

In the current era with advanced technology and various measures to treat patent ductus arteriosus, we have to consider the best and most appropriate one for each patient in each situation. We have to consider safety, invasiveness, cost-effectiveness, and also, availability or feasibility in each institution. Now, at our hospital, we prefer to perform both ligation and clipping in infants and children. For adult patients with small ductus, we will also perform both ligation and clipping. But for adult patients with large ductus or pulmonary hypertension, transthoracic closure is rather dangerous. In these cases, transcatheter closure with amplatzer device or closure under cardiopulmonary bypass may be safer.<sup>17</sup>

## Conclusion

**Combined ligation and clipping was effective for closure of PDA in infants and children. This technique was safe and simple. It could give complete closure of PDA with minimal risk. With small mini-thoracotomy, the patients could be discharged home within one or two days thereby shortening the length of hospital stay.**

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