行政院國家科學委員會專題研究計畫 成果報告

以心導管關閉心房中隔缺損時不做氣球導管測量缺損尺寸之可行性:以二維及三維超音波做選擇關閉器之指引

研究成果報告(精簡版)

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以心導管關閉心房中膈缺損時不做氣球導管測量缺損尺寸之可行性:以二維及三維超音波做選擇關閉器之指引

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一、中文摘要

目的:在於探討心導管關閉心房中膈缺損是否可以不用氣球導管來測量缺損之尺寸。

方法與結果：

1.方法: 本研究收入 243 位病人(第一組)年齡 2.1 至 76 歲不等(中位數 22 歲)進行心導管缺缺損關閉手術不用氣球導管測量缺損大小，缺損測量使用經食道超音波來測量各種不同切面最大的直徑，關閉器選用的方法如下:若缺損大於 14㎜，則選用關閉器直徑大於缺損 5-8㎜，若缺損小於 14mm，則選用關閉器直徑大於缺損 4-6mm，243 病人關閉的結果與過去使用氣球導管測量的 271 例病人(第二組)做比較。

結果: 第一組 243 不做氣球導管測量的病人，最大缺損直徑由 5.2 至 37mm 不等(平均 17.5±6.6㎜，中位數 17mm)，心導管治療 238 位病

人成功，5 例失敗，失敗有 2 例隔日關閉器脫落，比較第一組與第二駐成功率(238/243 比上 263/271)，脫落比率(2/243 比上 2/271)以及 3 個月追蹤時關閉比率(94.1 比 95.8%)沒有顯著差異，不過第一組病人年紀較大(26.6±20.2 比上 19.1±17.6 歲)，第一組缺損也較大(17.5±6.6mm 比上 14.1±5.9㎜)，Qp/Qs 值第一組較大(2.77±1.11 比上 2.48±0.97)，而第一組使用的關閉器也較大(23.1±8.1 比上 19.6±7mm，$p<0.01$) 。

結論：心導管治療心房中膈缺損時，不一定要使用氣球導管測量缺損尺寸。

關鍵詞：心房中膈缺損, 經導管關閉, 氣球測量尺寸, 經食道心臟超音波

(accepted: Catheterization and Cardiovascular interventions）

Transcatheter closure of atrial septal defect without balloon sizing

Objective: To evaluate the safety and feasibility of transcatheter closure of atrial septal defect (ASD) without balloon sizing.

Methods: A total of 243 patients (group I), aged 2.1~76 years (median 22 years), underwent transcatheter closure of ASD without balloon sizing. The maximal diameter of the defect was measured on transesophageal echocardiographic (TEE) images. The size of device selected was generally 4-6 mm and 5-8 mm larger than the maximal diameter, if the defect was ‹14 mm and ≥14 mm, respectively. The results of ASD closure in group I were compared with those of 271 patients (group II, median age 11 years) who underwent ASD closure with balloon sizing prior to the study period.

Results: Of the 243 patients in group I, the maximal defect diameter ranged from 5.2 to 37 mm (mean 17.5 ± 6.6 mm, median 17 mm). A total of 247 Amplatzer septal occluders were deployed in 240 patients. Two patients were found to develop distal embolization of a device the next day. Therefore, failure occurred in 5 patients. Comparing the results between group I and group II, there was no significant difference in success rate (238/243 vs. 263/271), incidence of embolization (2/243 vs. 2/271) and complete closure rate at 3-month follow-up (94.1% vs. 95.8%). There is significant difference in mean age (26.6 ± 20.2 vs. 19.1 ± 17.6),

maximal defect diameter (17.5 ± 6.6 vs. 14.1 ± 5.9 mm) and Qp/Qs ratio (2.77 ± 1.11 vs. 2.48 ± 0.97) between group I and II. The mean diameter of device used was significantly larger in group I than in group II (23.1 ± 8.1 vs. 19.6 ± 7 mm, p ‹ 0.001).

Conclusions: Balloon sizing may not be necessary in transcatheter closure of ASD.

INTRODUCTION

Transcatheter closure has been accepted as an alternative to surgery in the treatment of secundum-type atrial septal defect (ASD). Amplatzer septal occluder is the most popular device for transcatheter closure of ASD because of a high success rate and low incidence of complication. [1-5] Balloon sizing of the defect has been regarded as an integral part of transcatheter closure of ASD. [6,7] The device size selected is usually identical to or within 2 mm larger than the stretch diameter of balloon sizing. [8,9] However, balloon sizing was considered not necessary in two recent studies. [10,11] We conducted this study to evaluate the feasibility and safety of transcatheter closure of ASD without balloon sizing. The results of ASD closure using Amplatzer septal occluder without balloon sizing were compared to those who underwent catheter closure with balloon sizing.

METHODS

Study subjects: During a 27-month period between May 2004 and July 2006, 252 patients with hemodynamically significant ASD underwent attempted transcatheter closure with the Amplatzer septal occluder (AGA Medical Corporation, Golden Valley, MN) in this institution. Patients with patent foramen ovale were not included in this study. After transesophageal echocardiography (TEE) evaluation, 3 patients were excluded from attempted closure because of presence of a very large defect and insufficient rims. Balloon sizing was considered as required in 6 patients: 3 with coronary sinus type ASD, 2 with multi-perforated defects and 1 with a defect adjacent to the coronary

sinus. Of the remaining 243 patients (84 males and 159 females), transcatheter closure of ASD was performed without balloon sizing of the defect. Their ages ranged from 2.1 to 76 years (mean 26.4 ± 20.2, median 22 years). Two patients had undergone ASD closure with a Buttoned device with moderate residual shunt. Six patients had other associated cardiovascular anomalies: 2 were with patent ductus arteriosus, 1 with cortriatriatum, 2 with restrictive ventricular septal defect, and 1 with tiny coronary arterial fistula. The results of ASD closure in the 243 patients without balloon sizing (group I) were compared with those of 271 patients (group II) who underwent attempted ASD closure with balloon sizing for selecting device size in this institution between April 1999 and April 2004. All these closure procedures were performed by a single interventionist. In the 271 patients, AGA balloons were used for balloon sizing (AGA Medical Corporation, Golden Valley, MN). Measurement of the waist of the balloon was performed with quantitative fluoroscopic analysis. A sizing plate was also used to ascertain the measurement under fluoroscopy. In case of discrepancies between fluoroscopic analysis and measurement with sizing plate, the latter measurement was used to select device size. The device diameter selected was usually equal to or within 2 mm larger than the stretched diameter. Several outcome parameters were compared between the two groups, including success rate, complete closure rate at 3-month follow-up, incidence of distal embolization and major complication rate. Procedural success was defined as a device in proper position with no or mild leak (residual shunt ≤2 mm) on echocardiography 1 day after the procedure. Exception was made in those cases with multi-perforated defects using a single device, a residual

shunting ‹4 mm through other defects was regarded as success. For those using a fenestrated device, a device in good position with a shunt across the fenestration was regarded as procedural success. Late embolization or occurrence of severe complication was regarded as procedural failure.

Selection of device diameter without balloon sizing: After general anesthesia, multi-plane TEE was performed in each patient. The diameters of defects were measured on two-dimensional images of TEE in various imaging planes. The maximal diameter of the defect was measured using atrial end-diastolic frames. A minimal diameter was also obtained from other imaging planes. In the presence of a very floppy and mobile rim, measurement of defect diameter was made between steadier rims (Figure 1), and the color flow jet width across the defect was also measured to provide supplementary information. In the current study, we modified the equations from the studies of Fisher et al. and Rao et al. to select the size of device. [12,13] In the early phase of this study, the device size selected was 4-6 mm larger than the maximal diameter of the defect if the maximal defect was ‹14 mm. If the maximal diameter was ≥14 mm, a device size selected was generally 6-8 mm larger than the maximal diameter. As more adverse events regarding oversizing devices were reported, the device size selected was 4-5 mm and 5-7 mm larger than defect diameter if the defect diameter ‹14 mm and ≥14 mm, respectively, in the mid and late phase of this study. In the presence of deficient rims, very floppy rims, or atrial septal aneurysm, one-size-larger device was chosen. However, the diameter of device should not be › 10 mm larger than maximal ASD diameter. The left disc diameter selected

should not exceed the maximal left atrial septal length measured with echocardiography. If the maximal diameter was greater than two times that of the minimal diameter, one-size-smaller device was selected. In multi-perforated ASDs, one-size-larger device was used in most patients. If two hemodynamically significant defects were ›7 mm apart, multiple devices were used.

Deployment of Amplatzer septal occluder: The technique of deployment of the Amplatzer septal occluder was similar to those described in the literature. [1,3,5] An appropriate-sized AGA sheath was used for delivery of the device. In several patients with a large defect and/or deficient rims, a Hausdorf-Lock sheath (Cook, Bloomington, IN) was used to deploy the device. Deployment of the device from the left upper pulmonary vein was generally performed in patients with a large defect. Before detachment of the device, TEE was performed to check the position of the device, presence of residual shunt, patency of coronary sinus and pulmonary veins, and mitral valve function. When the position of the device was not well visualized on TEE images, particularly the posterior inferior rim, transthoracic and subcostal echocardiography was used as adjunct to TEE to monitor device position. After release of the device, an angiogram in the right atrium was performed. Following the procedure, patients were sent to the intensive care unit or recovery room for monitoring vital signs. Patients were discharged 2 days after the procedure. Clinical evaluation and echocardiography were performed 1 month, 3 months, 6 months, 12 months & then yearly after the procedure. Low dose of aspirin (3-5 mg/kg/day) was given for 6 months.

Statistical methods: All data were expressed as mean ± Standard diameter. Student t-test was used to evaluate the significance of difference of continuous variables between the two groups. Chi-square analysis or Fisher's exact test was used to assess the significance of difference in various parameters between the two groups. Linear regression analysis was performed to assess the correlation between TEE diameter of the defect and size of the device deployed. A p value ‹0.05 was considered statistically significant.

RESULTS

Acute results: The results of transcatheter closure in group I and group II are summarized in a flow chart (Figure 2). Among the 243 patients of group I, 24 patients had multi-perforated ASDs and 15 patients had atrial septal aneurysm. The mean Qp/Qs ratio was 2.77 ± 1.11. Transcatheter closure of 250 defects was attempted. The maximal diameter of the defect ranged from 5.2 to 37 mm (mean 17.5 ± 6.6 mm, median 17 mm). Device deployment failed in 3 patients. A total of 247 devices were deployed in 240 patients. The mean diameter of the device deployed was 23.1 ± 8.1 mm (ranging from 8 mm to 40 mm, median 22 mm). Despite the fact that the device was in proper position after wiggling, distal embolization of the device was found in 2 patients 1 day after the procedure. In one patient with a 13.5-mm defect, an 18-mm device migrated to the aortic arch. The device was retrieved percutaneously using a snare through a 12 Fr AGA sheath. Balloon sizing performed in the second attempt showed a stretched diameter of 20.2 mm. Therefore, a 22-mm device was deployed with success. In another patient with a defect measured 20.2 mm and

deficiency in one rim, a 28-mm device was deployed, but it was found to be in the main pulmonary artery the next day. The attempt to retrieve the 28-mm device was not successful because the device could not be resheathed into a 12 Fr AGA sheath after snaring the screw. The patient was sent for surgery. During operation, deficiency in the rim at the inferior aspect of the defect was found. Therefore, transcatheter closure was successful in 238 patients.

Three patients required one-size-larger device to achieve success because the initially selected device pulled through repeatedly despite the efforts to deploy the device from left upper pulmonary vein or use of a Hausdorf-Lock sheath. Impingement of mitral valve by the device was encountered in 2 children, detected on TEE images before detachment of the device. Of the 2 children, one weighing 13.5 kg with a maximal defect diameter of 17.8 mm received a 24-mm device which impinged the mitral valve and was retrieved. Then, a 22-mm device was deployed. In another, who weighed 10.7 kg with a defect of 19 mm, a 24-mm device was deployed, resulting in mitral regurgitation. The device was resheathed. Then a smaller-size device (22 mm) was implanted. No mitral valve impingement or regurgitation was detected after detachment of the device in both patients. No patient had mushrooming deformity of the device. A fenestrated device was used in 7 patients: 4 with severe heart failure, 2 with severe pulmonary hypertension, and 1 with hypoplasia of the right ventricle. When regression analysis was performed between device diameter (y) and maximal defect diameter (x) in the group I patients (no balloon sizing), the following equation was yielded: $y = 1.16$

x+2.76 mm, r^2=0.91 (Figure 3). The correlation between the maximal defect diameter (x) and the device size (y) was y = 1.17 x + 2.3 mm, r^2= 0.8, and y = 1.1x+ 4.2 mm, r^2=0.81, if x ‹14 mm (71 defects) and x ≥14 mm (176 defects), respectively. In group I, the mean ratio between device diameter and defect diameter was 1.34 ± 0.15. The mean device and defect diameter ratio was 1.41 ± 0.13 and 1.31 ± 0.14, if maximal defect diameter ‹14 mm and › 14 mm respectively. While in group 2, if linear regression analysis was performed between defect size (x) and device size (y), a formula of y=1.1x + 3.98 mm, r^2=0.86, was yielded.

Complications: Two patients, described above, developed distal embolization of a device the next day. During cardiac catheterization, one patient had atrial flutter with 2:1 block which was terminated by cardioversion. Four patients experienced supraventricular tachycardia which was terminated after administration of adenosine or Inderal. One patient developed second degree atrioventricular block, which recovered 2 days later. No other serious complications occurred in group I.

Follow-up: During follow-up, symptomatic improvement was documented in most patients. In the 3-month echocardiographic follow-up, complete closure was documented in 224 out of 238 patients (94.1%). Impingement of mitral valve by the device resulting in regurgitation was appreciated on the echocardiography in no patients. In one patient receiving implantation with a fenestrated 30 mm-device because of severe heart failure requiring intubation, an 8-mm device was used to close the fenestration 6 months later. Four patients experienced

new-onset atrial arrhythmia within 6 months after device closure, and all responded to medication. After discontinuation of mediation, atrial arrhythmia did not occur in any of the four.

Comparison of outcome parameters between no balloon sizing and balloon sizing groups: When the outcome parameters were compared between group I and group II, there was no significant difference in terms of success rate (238/243 vs. 263/271) and incidence of embolization (2/243 vs. 2/271). The mean age and Qp/Qs ratio were significantly higher in group I than in group II. The mean maximal diameter of the defect was significantly larger in group I than in group II. (17.5 ± 6.6 vs. 14.1 ± 5.9 mm, p ‹0.001) The mean diameter of device used was significantly larger in group I than in group II (23.1 ± 8.1 mm vs. 19.6 ± 7 mm, P ‹ 0.001) (Table 1). Comparing major complication rates between the two groups, there was no statistically significant difference (2/243 vs. 4/271) (Table 2). There was also no significant difference between the two groups in complete closure rate in the 3-month follow-up echocardiography (94.1% vs. 95.8%). There were no late complications in either group. Thrombus formation was found in no patients in both groups.

DISCUSSION

Advantages and disadvantages of balloon sizing: Accurate selection of device size is crucial for success of ASD closure with the Amplatzer septal occluder. Implanting a too-large device may carry risks of mushrooming deformity of the device, impingement of cardiovascular structure, and serious late complications, [14,15] while using too small a

device may cause instability or distal embolization of the device and residual shunting. [9] Therefore, balloon sizing has been considered to be an integral part of transcatheter closure of ASD with the Amplatzer septal occluder, where the diameter of waist of the balloon measured on the cineangiography or TEE images was used to select the diameter of the device. However, there are disadvantages of balloon sizing. Bradycardia and hypotension may occur after prolonged inflation of the balloon due to obstruction in diastolic filling. [13] Balloon sizing may cause enlargement of the defect by tearing of the flap valve of the septum primum. [16] Therefore, two recent studies recommended technique for balloon sizing by producing no waist to avoid overstretching the defect. [14,17] Sometimes, balloon sizing may incur inaccuracy, since the markers on the catheter or waist of balloon may not be in good profile with cine projections. [14] Additionally, without balloon sizing, the cost of the balloon catheter can be saved, and the fluoroscopic time and procedure time can be shortened.

Correlation between echocardiographic measurement and balloon sizing of the defect: There is good linear correlation between echocardiographic measurement of the defect and balloon stretched diameter. [18-22] In a study by El-Said et al., the stretched diameter exceeded TEE diameter and transthoracic echocardiographic diameter by an average of 13.2% and 22%, respectively.[18] In the study by Fisher et al, a good linear correlation (r=0.83) was found between defect diameter and balloon stretched diameter (SD), SD = 1.01 x TEE diameter + 5.28 mm. [12] In a study by Walsh et al., an equation of SD= 1.06 x TEE

diameter +4.4 mm, r=0.87, was yielded. [20] A recent article by Carcagni et al. showed that maximal steadier rim border (thickness ≥2.5 mm) distance on TEE images correlated well with stretched balloon diameter in adults. [21] Transthoracic echocardiography can also be used to predict the stretched diameter. Rao et al. proposed an equation of SD = 1.05 x echocardiographic diameter + 5.49 mm. [13] A similar formula of SD = 1.21 x echocardiographic diameter + 0.67 mm was yielded in a study by Godart et al. [19] In a study by Zanchetta et al, no balloon sizing was performed during transcatheter closure of ASD, where waist diameter was chosen based on the r value obtained from intracardiac echocardiographic images【$r=\sqrt{(C^2+P^2)}$, C is the foci half-distance of the fossa ovalis and P is its semi-latus rectum.】[22] In another study of Zanchetta, an equation of $d = \sqrt{(a \times b)}$ was obtained, in which a and b were major axes of intracardiac echocardiography on aortic and 4-chamber plane, respectively, and d was the diameter of device used. [11] In a study by Amin et al, balloon sizing was considered unnecessary and a device that was 2-4 mm larger than intracardiac echocardiographic diameter was chosen. [10]

In this study, the mean device diameter (23.1 mm) was 5.6 mm larger than maximal defect diameter (17.5 mm). The device size selected in this study seemed to agree well with those reported by Carlson et al., in which the mean device diameter was larger than mean TEE diameter by 5.6 ± 2.2 mm in the waist negative group. [17] Adding 6 mm to TEE diameter can give a good estimate of the stretched diameter in most cases. [20] In the article by Amin et al., the mean device size in the adverse event group

was 8 mm (148 %) larger than the diameter of the defect vs. 4.9 mm (138 %) larger in the FDA trial group. [14] In group I patients of this series, the mean device/defect diameter ratio was 1.34 ± 0.15.

Recently, 3-D TEE has been used to aid selection of device size. [23] There is good correlation between 3-D TEE measurement of maximal diameter and balloon stretched diameter in patients with a single defect.

Feasibility of transcatheter closure of ASD without balloon sizing: From the results of this study, it is safe and feasible to undergo catheter closure without balloon sizing. There could be some situations such as presence of atrial septal aneurysm and a very floppy rim, or deficient rims where difficulties in deployment of device and instabilities of device after release could be a problem. A one-size-larger device has been recommended to achieve success in these situations. [4,12,24] In this study, device diameter selected was generally within 8 mm larger than defect diameter in those situation.

In this series, 2 patients without balloon sizing developed distal embolization of the device. The incidence of embolization of device in the current study was slightly higher than those reported in the literature (0.82 % vs. 0.55 %). [25] Of the two patients, complicated with distal embolization, one had a defect measured 13.5 mm with deficiency in the superior anterior rim and the other had a defect measured 20.2 mm with deficiency in the inferior-posterior rim. In the former patient, the embolization was incriminated to improper position of the 18-mm device, which sandwiched the septum primum instead of the thick muscular septum secundum. In the latter patient, deficiency in the inferior-posterior

rim, which was confirmed at surgery, could be the reason for device embolization. Impingement of mitral valve was observed in 2 patients after deployment of the initial devices, which were smaller than that recommended by formula due to the limitation in atrial septal length. Both patients were ‹4 years of age and with a large defect and deficient rims. One-size-smaller device was deployed after retrieval of the initial device in both patients. In the current study, 6 patients required further adjustment of device size: 3 after unsuccessful attempts, 2 after impingement of mitral valve, and 1 after embolization.

The mean diameter of device used was significantly larger in group I than in group II. This can be explained by the fact that the mean age as well as mean maximal defect diameter were significantly higher in group I than in group Ⅱ, because there was a significantly higher percentage of adult patients in group I. The mean diameter of the defect in adults is usually larger than that in children. The mean Qp/Qs ratio was also higher in group I. Furthermore we were more cautious in patient selection in our early experience, many patients were excluded from attempted catheter closure because of a too-large defect relative to body size. After availability of larger-size devices and improvement in transcatheter technique, there were very few patients referred to surgery without an attempt at catheter closure.

During the study period, balloon sizing was considered as required in 6 patients, of whom 2 had multi-perforated defects. In the presence of multi-perforated defects and atrial septal aneurysm, the diameter of defects were difficult to assess accurately with two-dimensional TEE

images alone, and balloon sizing was required in some cases to aid the selection of device diameter.

Limitation of this study: We did not perform a randomized study. Instead, historic controls were used. Although, the two groups were from different time periods with significant difference in mean age, defect diameter and Qp/Qs ratio, there were no significant differences in various result parameters between the two groups. The percentage of patients excluded from attempted closure was higher in the era of routine balloon sizing (3/252 vs. 16/287) when presence of a large defect was the main reason for exclusion from attempted closure. With the improvement in transcatheter technique and availability of larger devices, catheter closure was attempted in every patient if there was ample rim towards mitral valve. In this study, we used 14 mm as cut off value for adding 4-6 mm or 5-8 mm to TEE defect diameter to select device size. This could be somewhat arbitrary, however it is based on the assumption that a larger defect is more frequently associated with deficiency in rims. So far, there have been no late complications. The long term results of catheter closure without balloon sizing await further studies.

Conclusion

Balloon sizing is generally not necessary in transcatheter closure of secundum type ASD using Amplatzer septal occluder.

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(Catheterization and Cardiovascular interventions)

出席國際學術會議心得報告

計畫編號	95-2314-B-002-293
計畫名稱	以心導管關閉心房中隔缺損時不做氣球導管測量缺損尺寸之可行性:以二維及三維超音波做選擇關閉器之指引
出國人員姓名 服務機關及職稱	台大醫院王主科副院長
會議時間地點	95 年 5 月波蘭華沙
會議名稱	第 42 屆歐洲小兒心臟醫學會
發表論文題目	經由心導管關閉冠狀靜脈竇型的心房中膈缺損

一、參加會議經過

歐洲小兒心臟醫學會是歐洲所有國家的小兒心臟醫學會組成的，每年輪流由幾個會員國家在不同地方舉辦，今年第 42 屆年會在波蘭的首都華沙舉行，我有一篇論文被接受口頭報告我在 5 月 14 日從台北出發，15 日上午才抵達波蘭華沙，華沙的街道相當乾淨整齊，建築非常典雅，另有幾棟新的建築聽說是建築師必定要參訪的 15 日下午大會開幕式，我的報告被安排在 18 日，會場在華沙郊外的一處會議中心，交通不太方便，都靠每天一班的 shuttle bus 接送，會場有三間會議廳，會議在三間會議廳同時進行，同時另有一個海報展示間，有幾篇是在海報前做五分鐘的口頭報告，posterior 共有九十幾篇，參加人數約有 800 多人，大部分為歐洲及美國醫師，我的報告題目是經由心導管關閉冠狀靜脈竇型的心房中膈缺損，雖然我不是全世界第一個使用心導管去關閉這種罕見的心房中膈缺損的人，但我們的病例有六例，是目前最大量成功的案例，由於這型的缺損非常少見，僅占心房中膈缺損的百分之一，連外科開刀的經驗也相當有限我報告這六例是如何做到診斷，並且使用多種影像系統來定位並顯示缺損形狀，之後完成關閉手術，當我報告之後，就有五六個人問了許多問題，有人認為心導管治療的困難度高，不如開刀來的簡單，有人認為關閉後冠狀動脈血液回流會受阻，我一一回答他們的問題，會後有人還跟我討論技術上的問題大會在 19 日下午閉幕我在 20 日上午搭機返台

II.與會心得

這次有幾個演講及報告相當值得注意，大會安排一系列的演講有關於心室中隔缺損的心導管關閉，從心室中隔缺損的型態缺損位置到關閉後的長期追蹤雖然安普拉茲關閉器成功率稍遜於開刀手術，但是一般的併發症較開刀少，除了一項併發症比外科高，就是房室傳導障礙(AV block)，發生的原因不外乎是關閉器壓迫房室結造成傳導的問題，也因為這個問題沒解決還沒通過美國 FDA 的審查，不過在歐洲一些國家已有好幾百例的經驗另外一個演講是有關法洛氏症手術後肺動脈嚴重逆流造成右心室衰竭時，可用心導管將一個放在血管支架上牛的靜脈瓣植入肺動脈瓣的位置，可有效的減少肺動脈逆流，效果相當好，而且通過歐盟的衛生主管機關的審查台灣這樣的病人相當多，不過家長接受開刀的意願相當低，所以心導管植入瓣膜應可取代開刀，讓右心室不至於衰而導致死亡，這是我們要努力爭取以造福國人歐洲各國小兒心臟醫師每年一次的會議，這是世界其他地區少有的會議，很多頂尖的研究都在此大會上發表成，獲益匪淺，亞洲地區最近才剛成立亞太小兒心臟的會議，不過每三年才一次，感覺緩不濟急，我們也是會員之一，還有努力的空間。

III.會議資料

Abstract 收錄在 Cardiology in the Young