1. Monitoring and Protection of the Infant Brain during Cardiac Surgery

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Introduction: Although the neonate or young infant is free of atherosclerosis and therefore the risk of particulate cerebral embolic injury during bypass is small, the extreme manipulations of perfusion parameters used in infant heart surgery expose the child to a significant risk of brain injury. We have undertaken prospective trials to study various perfusion parameters in our infant cardiac surgical population. We have also studied mechanisms of injury in a piglet model and have gained important insights from near infra-red spectroscopy, a new monitoring modality which provides on-line information regarding cerebral oxygen delivery.

Methods: Circulatory arrest trial: Neonates with TGA had a higher incidence of seizures when randomized to circulatory arrest versus continuous bypass. Seizures were a marker for worse late developmental outcome. By 4 years even children who had had continuous bypass had a less than expected IQ, suggesting that technical aspects of bypass such as pH strategy could be improved.

pH Trial: Infants randomized to the alpha stat strategy had a higher incidence of adverse events including death. Median developmental scores at one year were worse with alpha stat.

Hematocrit trial: An ongoing study. Metaanalysis of the 2 previous trials with regression studies of hematocrit effect have revealed that higher hematocrit is associated with improved post-operative cardiac output and developmental scores.

Laboratory studies: Near infra-red spectroscopy combined with magnetic resonance spectroscopy in a piglet model suggests that the combination of hypothermia, alkalosis and hemodilution in the setting of the fixed cardiac output of CPB importantly limits oxygen delivery in the early minutes of CPB when the brain is still warm. Post-operative hyperthermia seriously exacerbates such injury.

Inferences: The use of circulatory arrest should be minimized. The pH stat strategy is preferred for infant CPB over the alpha stat strategy. A higher hematocrit e.g. 30% may be preferable to 20%. Post-operative fever should be strenuously avoided. Surgeons should be aware that CPB parameters can have subtle but important effects on late developmental outcome.
2. Pulmonary Thromboendarterectomy for Chronic Thromboembolic Pulmonary Hypertension: Experience and Results with 175 Operations

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Background: Pulmonary thromboendarterectomy (PTE) is an effective and potentially curative surgical procedure in patients with chronic thromboembolic pulmonary hypertension. Between June 1989 and October 1998, 175 patients underwent PTE at our institution. Multiple changes in surgical approach and postoperative management have been implemented since January 1995. Our current principles of diagnosis, patient selection, surgical technique and early results of 66 consecutive PTE operations performed between January 1995 and October 1998 are reported. In addition, we report long-term follow-up results in a series of 41 patients operated 5 or more years ago.

Methods: Between January 1995 and October 1998, sixty-six patients (28 females, 38 males, mean age 54, range 22 to 73 years) underwent PTE using cardiopulmonary bypass, deep hypothermia and circulatory arrest periods. Preoperative NYHA functional class was III in 40 and IV in 26 patients. Preoperative pulmonary vascular resistance (PVR) and mean pulmonary artery pressure (mPAP) were elevated at 998 ± 213 dynes·s·cm⁻¹ and 49 ± 11 mmHg respectively.

Forty-one patients (21 females, 20 males, mean age 41 years, preoperative NYHA class II/III/IV: n=1/25/15) operated between June 1989 and December 1992 were reassessed 60 to 73 months (mean 64 months) after surgery using clinical, radiologic, hemodynamic and echocardiographic investigations.

Early results: The perioperative mortality rate was 6.1% (4 of 66). The mean circulatory arrest time was 36 minutes (range 8 to 72 minutes) with a significant decrease over time. The median duration of postoperative mechanical ventilation was 36 hours (range 9 to 390 hours). In 62 survivors, PVR and mPAP were significantly reduced to 302 ± 136 dynes·s·cm⁻¹ (p<0.001) and 25 ± 9 mmHg (p<0.001) respectively.

Late results: At follow-up, all patients reported a marked improvement of their clinical symptoms. Twenty patients were identified as NYHA class I, 18 as NYHA class II and 3 patients were in class III. PVR and mPAP were significantly reduced compared to preoperative and postoperative measurements. Radiologic and echocardiographic examinations revealed a significant reduction of right heart dimensions and a recovery of right heart function.

Conclusions: In patients with severe chronic thromboembolic hypertension, good and persistent hemodynamic and symptomatic improvements can be achieved by pulmonary thromboendarterectomy. Based on a learning curve and by changes of the perioperative management, the operative risk can be improved to an acceptable level.
Mitral valve repair is nowadays a recognized method to surgically treat mitral valve regurgitation. Alain Carpentier has during the past twenty years worked on the improvement of the surgical techniques, but the milestone of his work has been the understanding of the "functional approach".

Another major breakthrough has been the onset of echocardiography whose role before, during and after the operation has grown to a point where echocardiographists should form tight teams with surgeons. The contributions of echocardiography in mitral valve repair are numerous: for the timing of surgery, for the precise description of the lesions, in recognizing intraoperative complications, left ventricular outflow tract obstruction or residual regurgitation, for the follow-up of the patients etc...

Mitral valve repair requires specific surgical training and skills even in what can be considered the most usual and simple lesion, the prolapse of the posterior leaflet whose standardized treatment is quadrangular resection and plication of the annulus. Nevertheless in a homogeneous cohort of 208 patients, other surgical techniques have been required: a sliding plasty in 98 patients, use of artificial chordae in 5 patients, papillary muscle shortening in 4 patients and removal of posterior annulus calcifications in 5 patients. These techniques resulted in a 100% rate of repair for this lesion for an operative mortality of 2.9% and a 6-year survival of 87%.

There is today little doubt that long time survival after surgery for mitral valve regurgitation is better after mitral valve repair than after mitral valve replacement. Two groups of patients with mitral valve regurgitation were compared. One group (433 patients) had mitral valve repair and the other (257 patients) mitral valve replacement with Medtronic-Hall prosthesis. The 7-year survival was 74% for the repair group and 58% for the replacement group. This difference was statistically significant. The same differences were observed in subgroups of patients having either isolated mitral valve regurgitation or associated with CABG.

It is interesting to note that at 7 years, the reoperation rate was 5% for the repair group and 9% for the replacement group. This underlines the durability and the stability of the repair techniques. The trend nowadays is to operate patients with severe mitral valve regurgitation at an early stage when they are not yet symptomatic the goal being to preserve the left ventricular function that might deteriorate unnoticed. Two groups of patients with isolated mitral valve regurgitation have been compared. Seventy-nine patients were non-symptomatic and one hundred eighty four symptomatic. The 7-year survival was 95% for the non-symptomatic group and 75% for the symptomatic group.

In conclusion, improvements in surgical techniques, a better understanding in particular with the help of echocardiography have given mitral valve repair safety, predictability, and durability. Mitral valve repair can be proposed to non-symptomatic to prevent left ventricular dysfunction.
4. Revascularization of Severely Ischemic Limbs by Staged Arteriovenous Reversal

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Abstract

Limb threatening ischemia is always due to Buerger’s disease in young and middle-aged patients and to arteriosclerosis among the older population. Treatment of extensive and diffuse arterial occlusive disease of the limb is still a problem remaining to be solved. To avoid the amputation of the limb or to limit it to the necrosed segments, we successfully applied staged arteriovenous reversal (AVR) to 138 patients (a total of 153 severely ischemic limbs) from January, 1984, to December, 1995. There were 106 men and 32 women. Their ages ranged from twenty-six to seventy-one years, averaging 48.7 years. The duration of symptoms ranged from fifteen days to seventeen years. Staged AVR was performed on 153 limbs (89 left and 64 right lower extremities, and both lower extremities in 15 patients). 112 patients were diagnosed as having Buerger’s disease, and 25 patients had arteriosclerosis. In 1 patient the popliteal artery was completely obstructed by acute emboli of atheromatous plaques. 3 patients with Buerger’s disease had not benefitted from lumbar sympathectomy or partial adrenalectomy done several years before coming to our hospital. Among the 138 patients with Buerger’s disease or arteriosclerosis, marked intermittent claudication occurred after they walked continuously for less than 500 meters. Extreme rest pain occurred both day and night in 127 of the limbs. One patient had had his right lower extremity amputated in another hospital three months before admission. Necrosis below the ankle joint was found in 52 patients, along with high fever and toxemia. There was necrosis or gangrene of the foot in 65 limbs. The patient with acute embolism of both popliteal arteries came to our hospital fifteen days after the onset of severe ischemia. He had high fever over 39°C and toxemia due to necrosis below the middle portion of the right lower leg. Immediate amputation on his right thigh was performed. Also, there were gangrene and necrosis on the second and third toes and ulceration on the dorsum of the lift foot. Arteriograms showed that the popliteal arteries were completely obstructed at their distal segment.

According to the different levels of the extensive and diffuse arterial occlusion, the arteriovenous reversal was formed of three different sites: (1) high-deep reversal produced between the external iliac, common femoral or superficial femoral artery and the superficial femoral vein; (2) low-deep reversal, made between the distal popliteal artery and the tibioperoneal venous trunk; and (3) superficial reversal, established between the distal popliteal artery and distal portion of the long saphenous vein.

As of June, 1996, 135 limbs have been followed up for 0.5~12 years, the postoperative results of the patients in this series are excellent or good.

The author suggest that the staged arteriovenous reversal is a new and effective approach in the treatment of extensive arterial occlusive disease of the limb.
5. ENDOVASCULAR STENT-GRAFT TREATMENT OF VASCULAR TRAUMA

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Vascular trauma, with special reference to arteriovenous fistulas and arterial false aneurysms, has been always considered a clinical challenge to vascular surgeons, and remains as a potential cause of late complications and death for many patients.

Increasing experience with civilian trauma has taught that traumatic arterial aneurysms, alone or associated with arteriovenous fistulas in some locations, are dangerous to approach and difficult to repair.

Since the beginning of modern vascular surgery, different therapeutic strategies have been employed, including direct revascularization, and more recently, attempts for a less invasive treatment.

The idea of endoluminal repair of arterial lesions was first conceptualized by Dotter and has later on attracted the attention of different groups all over the world.

In 1991, the first clinical application of a temporary endovascular means of sealing a false aneurysm was initially published by Becker, but early attempts of endoluminal repair of vascular trauma had been carried out to Argentina before.

According with new original concepts, Dr. Juan Parodi, Dr. Schonholtz and co-workers began in Argentina to develop a system of endovascular treatment of arterial aneurysms, dissections, obstructive disease and arterial trauma in 1976. By 1990 it was possible to report the first clinical case of treatment of an aortic aneurysm by endoluminal techniques. Within two years, the same group employed the endoluminal approach to treat a patient with a large arteriovenous fistula in the subclavian region. This preliminary successfull result increase the interest in Argentina for exploring the technique further.

The following report is based on the analysis of lessons learned in 29 cases treated in Buenos Aires with this novel endovascular approach, guided by the teachings of Dr. Parodi and Dr. Schonholtz, whose pioneering experiences are well recognized in Argentina.

The lesions included 18 post-traumatic arteriovenous fistulas and 11 false aneurysms, located in neck, abdomen, upper and lower extremities. The cause was penetrating trauma in all but one.

The guiding principle was the occlusion of the arterial injury from within the arterial lumen and this was accomplished by implanting a tubular metallic mesh (stent), covered by polyester fabric, polytetrafluoroethylene, polycarbonate urethane polymer or autologous vein.

All patients but one had successfull primary result as confirmed by clinical examination and both color-duplex scans and angiography.

Two patients died due to non-related causes. One patient had a minor local complication. Three patients developed late occlusions but remained asymptomatic. Two more patients showed stenosis, which were successfully dilated without further complications.

In summary, 21 out of 29 patients continue to demonstrate stent graft patency and remain asymptomatic after 24 months of mean follow-up.

This short experience has initially proved feasibility of endoluminal repair of false aneurysms and arteriovenous fistulas. The procedure is new, and time is needed to define the future role of this innovative approach. The technique is certainly less invasive and probably cost-effective, and compares favorably to standard surgical treatment in selected cases.