The elephant trunk technique: operative results in 100 consecutive patients

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Abstract

Objectives: To describe morbidity and mortality in patients undergoing the elephant trunk (ET) implantation as the first stage in the repair of their mega aorta and to assess determinants for the occurrence of complications.

Methods: One hundred consecutive patients undergoing an ET implantation between 1984 and June 2001 were retrospectively analyzed. The ET was implanted as an extension of an isolated aortic arch (1%), an aortic valve replacement + ascending aorta + arch (14%), a root replacement + ascending aorta + arch (37%) and an ascending aorta + arch (48%). Indications for surgery were acute aortic dissection (1%), an inflammatory aneurysm (3%), chronic post-dissection (31%) or degenerative (65%) aneurysm. Marfan syndrome was present in six patients. For cerebral protection, we used isolated deep hypothermic circulatory arrest (7%), deep hypothermic circulatory arrest combined with uni- or bilateral antegrade cerebral perfusion (18%) or isolated uni- or bilateral antegrade cerebral perfusion (75%). Uni- and multivariate analysis was used.

Results: There were no intraoperative deaths. Hospital mortality was 8%. The causes of death were cardiac in one, rupture of a remote aneurysm in three, tamponade in one and sepsis in three. After multivariate analysis, no single factor emerged as a risk factor for hospital mortality. Permanent and transient neurologic dysfunction occurred in 4 and 2%, respectively. Univariate analysis showed the operative period before 1990 (P = 0.029) and emergency (P = 0.018) as significant factors for postoperative neurologic dysfunction; after stepwise logistic regression analysis, only emergent operation retained significance (P = 0.005). Permanent hoarseness, total atrioventricular block requiring pacemaker implantation and rethoracotomy for bleeding occurred in 17, 2 and 30%, respectively.

Conclusions: The first step in the repair of a mega aorta, the implantation of an ET, can be performed with a low mortality and an acceptable morbidity. The risk of central neurologic damage is higher in emergency interventions. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Elephant trunk; Aortic aneurysm; Mega aorta; Aortic arch surgery

1. Introduction

The genius idea of the proximal elephant trunk (ET), a free-floating extension of a vascular aortic arch prosthesis into the proximal descending aorta, was described first by Hans Borst et al. in 1983 [1]. In 1995, the Hannover experience was thoroughly investigated by Markus Heinemann [2]. Already in 1975, Griep et al. had reported an original unfolding technique of the prosthesis using deep hypothermia for replacement of the aortic arch [3]. The use of an ET is indicated in patients with diffuse aortic disease needing a two staged repair: ascending and/or arch replacement as a first step and later, the second stage consisting of descending thoracic or thoracoabdominal repair. Probably, the most important advantage of the ET is felt at the subsequent repair of the aortic disease and lies in the avoidance of a difficult dissection at the previous anastomotic region where firm adhesions are to be expected and dissection might be hazardous. Our experience with this technique is reported.

2. Patients and methods

2.1. Patient selection

We retrospectively analyzed 100 consecutive patient charts who underwent a proximal ET procedure between 1984 and June 2001. Mean age was 66.5 ± 9.7 years. Forty-two percent were men and 58% female. The under-
lying aortic pathology is explained in Table 1. Six patients had the Marfan syndrome. Surgical procedures are listed in Table 2. In 22 patients, it was a reoperation: in 20 a first, in one a second and in another patient a third reoperation (mostly after supracoronary ascending aortic replacement or after a Bentall). There were no patients with preoperative left vocal cord paralysis. All but four patients were operated on electively: these patients were hemodynamically unstable. Concomitant procedures are listed in Table 3.

In 44 patients, the second stage was performed with a mean interval of 341 days ± 375 (range 19–1631) after the first step: a partial or total descending aortic replacement was performed in six patients and a thoracoabdominal repair in 38 patients. Up to now, 48 patients did not receive their second stage intervention. The reasons for this delay are multiple: actually, three patients are awaiting their second procedure, in 32 patients the diameter of the downstream aneurysm has not reached our surgical limit (6 cm for the descending aorta in degenerative aneurysms or 5 cm for Marfan patients, 5 cm for the abdominal aorta), two patients refused their second stage and 11 patients died before the second step was performed. Of these 11 patients, two had prosthetic infection and they were judged to be too high risk for any other procedure, one died after 28 days of an unknown cause, two patients were operated unfit for the second stage (one of them ruptured on day 260, one died of heart decompensation), two patients died due to neurologic consequences of the first intervention on day 41 and 116, four patients ruptured on day 36, 40, 195 (the day before the second procedure was planned), 1008 (19 days before the second stage was planned). At time of the latest evaluation, the maximal aneurysm diameter of the latter four patients who ruptured was 4.6, 5.2, 6.2, and 6.8 cm, respectively.

### Table 1
**Surgical indications**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atherosclerotic aneurysm</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Postdissection aneurysm</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Inflammatory aneurysm</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Acute type A dissection</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 2
**Surgical procedures**

<table>
<thead>
<tr>
<th>Surgical procedure</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolated arch replacement + ET</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Ascending aorta + arch + ET</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>Aortic root + ascending aorta + arch + ET</td>
<td>37</td>
<td>37</td>
</tr>
<tr>
<td>AVR + ascending aorta + arch + ET</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

* ET = elephant trunk, AVR = aortic valve replacement.

### Table 3
**Concomitant procedures**

<table>
<thead>
<tr>
<th>Associated procedure</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
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<tr>
<td>CABG</td>
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<td>16</td>
</tr>
<tr>
<td>AVP</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>MVP</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Separate bypass to carotid bifurcation</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Correction of false aneurysm of femoral artery</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Separate bypass to subclavian artery or anonymous artery</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>MVP + CABG</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

* CABG = coronary artery bypass grafting, AVP = aortic valve plasty, MVP = mitral valve plasty, MVR = mitral valve replacement.

2.2. Operative procedure

Initially, we used the modified technique of Borst as it was described by Crawford [4]. The diameter of the dacron prosthesis is chosen after appropriate sizing of the aorta at the level of the left subclavian artery. A long heavy stay suture marks the proximal end of the prosthesis (ascending and/or proximal aortic arch). This part is then invaginated into the trunk part. This suture, which hangs out of the lumen of the folded prosthesis, will facilitate the unfolding process. The extent of invagination will determine the length of the trunk as well as the subsequent proximal part of the prosthesis. The whole graft is then inserted into the descending aorta; the double fold is positioned at the level of the distal arch anastomosis. In case of chronic dissection, all clots must be carefully removed out of the false lumen and the intimal flap must be resected over a length substantially longer than the trunk length in order to avoid trunk entrapment. In case of acute dissection, the layers should be united using teflon felt or a synthetic glue. Then the distal anastomosis is performed just distally to the origin of the left subclavian artery. In the exceptional circumstance, in which the diameter of the native aorta at the level of the left subclavian artery considerably surpasses that of the desired vascular prosthesis, we suppose to plicate the aorta in order to reduce its diameter and obtain congruence between prosthesis and aorta. After having constructed the distal anastomosis and before tying down the suture, the downstream aorta can be de-aired by resuming temporarily the retrograde flow from the femoral artery cannula. Then the prosthesis should be unfolded by traction on the stay suture. This facilitates gentle retrieval of the proximal part of the prosthesis. Afterwards an oval opening is cut into the prosthesis and the cerebral vessels are reimplanted as one island.

Since 1996, we have been using more often prefabricated aortic arch prostheses (InterGard Aortic Arch from Interventional, La Ciotat, France) with side branches for the head vessels (39% of the total group). This makes the invagination technique almost impossible and the predetermined length of the trunk must simply be inserted into the descending aorta. Thereafter a circular anastomosis is performed which is more cumbersome due to the presence of the pros-
thetic arch side branches, which might interfere with an optimal view.

By means of the prosthetic side-arms, all the cerebral vessels can be reimplanted using various lengths of these separate branches.

It is essential to switch perfusion from retrograde to antegrade using a Y-piece in the arterial line via a cannula inserted directly in the arch prosthesis or alternatively via a side prosthesis sewn onto or already present on the prefabricated arch prosthesis opposite to the most distal arch vessel side branch. In the island reimplantation technique, the antegrade flow is restarted after the arch vessel reimplantation prolonging the time of total body ischemia. In the prefabricated arch prosthesis technique, antegrade perfusion is resumed after the left subclavian anastomosis is performed. Afterwards, one can choose to return to the heart first or to continue with the separate arch vessel anastomoses. We did not use intraoperative transesophageal echocardiography to verify the placement of the ET.

Cerebral protection was achieved either using deep hypothermic circulatory arrest (iso-electric electroencephalogram and rectal or nasopharyngeal temperature of 18°C (7%), antegrade selective perfusion (uni- or bilateral) (75%) or a combination of both (18%). These techniques have been described extensively [5,6]. We did not use retrograde cerebral perfusion.

Subsequent distal repair (descending thoracic or thoracoabdominal) is performed using left heart bypass. During this repair, the midportion of the descending aorta distal to the free-floating end of the trunk (depending on aneurysm contours) is clamped first and the proximal part of the descending aneurysm in which the elephant trunk is to be expected (a few centimeters below the anastomotic suture line of the trunk), is opened longitudinally at its lateral aspect over a very short distance (maximally 2 cm). Through this incision, the trunk can be felt or becomes immediately visible lying against the lateral wall of the aneurysm obliterating the incision made in the aneurysmal wall. The trunk is grasped and clamped. This causes hardly any blood loss at all. However, abrupt but short bleeding must be anticipated. If the trunk cannot be found in this way, it is due to the fact that the aneurysm has been opened too distally.

2.3. Statistical analysis

All data were analyzed using SPSS (Statistical Package for Social Sciences, SPSS Inc., Chicago, IL) for Windows 8.0. Continuous variables are expressed as the mean ± one standard deviation and categorical variables as percentages. The relationship between independent pre-, intra- and postoperative variables and hospital mortality or postoperative neurologic outcome was investigated by univariate analysis (using χ², Fisher’s exact test or Mann–Whitney U test). A P value of 0.05 was chosen for retention in the multivariate model. Logistic regression analysis was used. Survival analysis was performed by the Kaplan–Meier product limit method and compared with the log-rank test. The independent pre-, intra- and postoperative variables analyzed are shown in the Appendix A.

3. Results

There were no intra-operative deaths. The mean duration of total cardiopulmonary bypass time, deep hypothermic circulatory arrest time and antegrade selective cerebral perfusion time was 229 ± 67, 54 ± 13, 93 ± 37 min, respectively. Eight patients died within 30 days of the operation giving an operative mortality of 8%: in the primary intervention group, the mortality was 8/78 (8%) versus 0/22 (0%) in the redo-group (P = 0.19). In the patient group operated on in emergency, 25% (1/4) died in the hospital versus 7.3% (7/96) in the elective group (P = 0.287). Before 1990, hospital mortality was 8.3% (2/24) versus 7.9% (6/76) after 1990 (P = 0.94). Hospital mortality differed not significantly between the different underlying aortic pathologies. The causes of hospital mortality are listed in Table 4. Univariate analysis showed that no single variable had a significant influence on hospital mortality.

Four patients awoke with a permanent central neurologic dysfunction and two patients had a transient deficit, which resolved completely before discharge. Postoperative neurologic dysfunction occurred more frequent in the patient group operated on in emergency (50%) compared to the elective group (4.2%) (P = 0.018). Operation before 1990 (P = 0.029) and emergency (P = 0.018) were significant univariate risk factors for central neurologic dysfunction (transient or permanent). After logistic regression analysis, only emergency operation was a risk factor for neurologic problems (P = 0.005).

Documented (by direct laryngoscopy) left recurrent nerve paralysis occurred in 17 patients. Other morbidity are listed in Table 5.

Cumulative survival at 3, 5 and 10 years is 72 ± 5, 65 ± 6 and 13 ± 10%, respectively (Fig. 1). Survival in the patient group that had a second stage repair was 82 ± 8% at 5 years versus 50 ± 8% in the patient group that had no second stage (P = 0.001) (Fig. 2).

4. Discussion

Aneurysms of the aortic arch are seldom limited to this

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Rupture remote aneurysm</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Tamponade</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sepsis</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
area and mostly extend into various parts of the up- and/or downstream aorta. Although some surgeons advocate one stage repair using a bilateral submammary anterior thoracotomy (clamshell incision) [7], a combined median sternotomy plus thoracoabdominal incision [8] or a median sternotomy plus lateral thoracotomy (T incision) [9], we feel that the operative risk of these very extensive procedures exceeds those of two separate interventions considerably. Especially, the expected respiratory problems in the early postoperative phase made us prefer the two steps repair for patients with these mega aortas: ET first except if there are signs that the descending or thoracoabdominal aorta needs priority.

From a technical point of view, we think that there are several particular pitfalls which should be stressed. Avoidance of the entrance of an already dissected operative field, the area around the distal aortic arch, the origin of the left subclavian artery in which vicinity runs the left vagus and left recurrent nerves as well as the thoracic duct and therefore avoiding laceration of vital vascular, neural and lymphatic tissue, was the most important reason why the idea of the elephant trunk was introduced by Borst. Marking the distal end of the ET by one or two metal clips for identification on plain chest roentgenogram or computer tomography seems unnecessary to us. Determination of the exact level of the end of the ET is not necessary for the next operative stage. If on the other hand, endovascular repair is planned at the second stage [10], it certainly might be useful to put clips on the end of the trunk since this will determine the exact level of the trunk end and it will facilitate trunk entry by the guide wire. The exact place where to open the aneurysm at the subsequent repair depends on the aneurysm contours, the level of the distal anastomosis performed during the first stage, the take-off of the left subclavian artery and the length of the trunk. Simply opening the proximal aorta around the ET, grabbing it and placing a clamp on it under moderate hypotension is an easy and quick manoeuvre that causes hardly any blood loss. The presence of clots in the blind pocket around the ET substantially prevents blood loss during this manœuvre. The administration of anticoagulation agents (coumadine or acetyl salisylic acid), the length of the trunk (the longer the trunk, the more stasis in the top of the blind pocket) and the diameter of the aneurysm at this particular segment will determine the formation of clots between the trunk and the native aneurysmal wall. Crawford described a patient with paraplegia after the insertion of a very long ET extending up to the diaphragm [4], probably due to the thrombotic occlusion of some critical intercostal arteries. Clots entrapped in the blind pocket can be removed at the second operation and but in any way remain outside the prosthetic reconstruction; therefore, there is no risk of thrombo-embolic complication in contrast to the ‘bidirectional’ ET [11] in which peripheral embolisation during the second (arch) stage might be a serious problem.

Trunk entrapment was completely absent in our series; extensive longitudinal excision of the intimal flap in case of chronic dissection and keeping the end of the trunk well above the double-channeled (dissected) aorta will avoid this potential problem. It will further guarantee that both the false and true lumen are equally perfused. We think that the ideal length of the trunk should be between 5 and 10 cm (less than 5 cm can give problems during the retrieval and longer than 10 cm can become dangerous for paraplegia).

The exact incidence of left recurrent nerve palsy in relation with this operation has never been reported before. We think

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Table 5
Morbidity

<table>
<thead>
<tr>
<th>Complication</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left vocal cord paralysis</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>Paraplegia</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Permanent central neurologic deficit</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Transient central neurologic deficit</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Rethoracotomy for bleeding</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Mediastinitis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Tracheotomy</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Temporary hemodialysis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Pacemaker implantation</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Fig. 1. Kaplan–Meier survival curve.

Fig. 2. Comparison of survival after ET procedure between the patient group with and without the second stage repair.
that it is important to try to avoid this complication since postoperative pulmonary complications might be worsened if the left vocal cord is paralyzed. Another important point is to check the function of both vocal cords before surgery since the aneurysm itself can cause left recurrent nerve dysfunction due to compression. Avoiding injury to this nerve is however difficult and unpredictable. Circumferentially stripping off 0.5 cm of peri-aortic tissue using a peanut when the anterior aspect of the vagus nerve has been identified and total circular transection of the aorta just distal to the left subclavian artery from inside the aorta, might overcome injury to the nerve. Very often, however, the quality of the aorta in the region of the left subclavian artery is bad since we are dealing with atherosclerotic aneurysms in most cases or postdissection aneurysms, which might be surrounded by dense adhesions. We suggest to inform the patient of this potential complication before surgery.

Our analysis has shown that none of the examined variables had a significant impact on hospital mortality. Probably postoperative central neurologic damage is a reflection of the intraoperative cerebral protection. With a 4% permanent neurologic dysfunction, we have reached a relative low incidence and we attribute this to a considerable extent to the antegrade cerebral perfusion, which allows us to perform this extensive repair in a safe manner [5]. Although the numbers are small, the results of the analysis show that the risk for postoperative neurologic problems is lower when the patient can be operated on electively. In this setting, optimal neurologic surveillance can be achieved using electro-encephalogram, transcranial doppler and transcranial oxymetry as we do it routinely.

The time interval between the insertion of the ET and the second stage is another interesting matter of discussion. Reasons for postponing the second stage might be an insufficient diameter of the descending or thoracoabdominal aneurysm, a suboptimal recovery from the first operation, the development of medical conditions that make the patient unfit for the completion operation such as serious chronic pulmonary disease or cancer. We believe the patient should be fit enough to undergo the second step since it might even be more demanding compared to the first. Of course, waiting too long increases the risk of rupture of a remote aneurysm especially if the aneurysm is very large or has expanded quickly and the blood pressure is not adequately regulated. This particular complication might have been avoided in 4–7 patients in our series.

One could argue that the indication to perform an ET was made quite liberally since about 48% of the patients did not receive their second stage. Since our mortality and morbidity rate does not differ between procedures on the aortic arch with or without the ET extension (except for left recurrent nerve paralysis), we indeed decide liberally to perform the ET procedure in view of the benefits at the subsequent repair as soon as an even limited distal dilatation or aneurysm is present.

We conclude that the ET procedure as a first step can be performed with a fairly low mortality rate. Maybe this can be attributed to the optimal cerebral protection using antegrade cerebral perfusion keeping the incidence of permanent neurologic sequelae low. In case of emergency surgery, it is probably unwise to perform this procedure. After the ET procedure, all patients need a close aortic surveillance with special emphasis on the risk factors for early rupture.

References


Appendix A

Pre-, intra- and postoperative variables tested for hospital mortality and postoperative central neurologic deficit. (ECC = extra corporeal circulation, DHCA = deep hypothermic circulatory arrest, ASCP = antegrade selective cerebral perfusion).

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Etiology of the aneurysm</td>
<td>Dissection or not</td>
</tr>
<tr>
<td>Aortic valve insufficiency</td>
<td>Coronary artery sclerosis</td>
</tr>
<tr>
<td>Marfan syndrome</td>
<td>Preoperative central neurologic status</td>
</tr>
</tbody>
</table>
Hoarseness before surgery
Date of intervention (before or after 1990)
Operative mode (elective versus emergent)
Primary versus redo surgery
ECC + DHCA versus ECC + DHCA + ASCP versus ECC + ASCP
Surgeon
Duration of ECC, myocardial ischemia, body arrest, DHCA and ASCP
(minutes)
Performed procedure
Associated procedures
Technical problems necessitating repeated cardioplegic arrest
Postoperative dialysis
Tracheotomy
Retrosternotomy
Myocardial infarction
Central neurologic dysfunction
Mediastinitis

Appendix B. Discussion

Dr J. Bachet (Paris, France): I have a problem that I would like you to solve as I never could solve it myself.

What are your guidelines for performing the second stage operation? The elephant trunk procedure is supposed to make the second stage easier if we do it rather early. But I remember a patient that I have reoperated on early this year: she refused for 3 years to have the second stage, and when I opened the chest, the elephant trunk was not very useful as it was stuck into the aneurysm because of the long time between the two procedures. Do you have a range of delays to solve this problem?

Dr Schepens: Regularly we use a protocol which commands that we evaluate the patient back after the first step after 3 months. Then he or she is seen at the outpatient clinic and a CT scan performed simultaneously. If the diameter of the descending or thoracoabdominal aneurysm comes in the neighborhood of 6 cm, which is our limit for degenerative or atherosclerotic aneurysms, then the second stage is planned. If it is a Marfan patient, the limit is 5 cm.

With regard to your specific problem that the elephant trunk was stuck into the descending aneurysm, we have never seen this. Normally, as you probably know, in the Netherlands, most people are continuously on warfarin, many times even if they have no mechanical heart valve; this means that the number of clots retaining into the pocket between the aeurysmal wall and the elephant trunk itself is mostly very limited. In our experience, we have never seen the elephant trunk stuck onto the wall of the descending aorta.

I hope I have answered your question sufficiently.

Dr A. Moritz (Frankfurt, Germany): I want to make a point for a one-stage approach. We did it through a transverse sternotomy, and as long as the aneurysm is confined to the chest, it gives you the opportunity to do it in one procedure and the only thing you change is that you have a slightly larger incision. The advantage of doing it is that probably your arrest times will be shorter because you only have to do one patch for the aortic arch and that’s it. The other things are done in periods of normal perfusion, or at least upper body perfusion.

I have one technical question. If you have a real large aneurysm at the subclavian artery, how do you perform the anastomosis? Sometimes you have to shrink a 6 cm aneurysm to a prosthesis size of 4 cm. That is technically not always easy, and I think there are also some limits by doing this.

Dr Schepens: With regard to your first question, we have no experience, as I said, with the single-step repair of these mega aortas using a transverse sternotomy, so I cannot answer your question objectively, but I will try to give my own idea.

We don’t do it because we think that the respiratory problems related to this approach are higher than if you do it in two steps, because we think, again, that median sternotomy is not so demanding for the respiratory system than doing a transverse incision, or a median sternotomy plus thoracotomy.

Above this, I think we have always tried to reimplant as much as possible intercostal arteries in descending or thoracoabdominal aortic aneurysm repair. I think, in my opinion, that it is very difficult to perform this from anteriorly. If you go through the lateral aspect of the thorax, this is much easier.

With regard to your second question about the discrepancy in diameter, we are lucky to say that in most of these patients, more specific in 99 of the 100 patients, the aortic diameter at the level of the left subclavian artery, or just beyond it, was quite narrow. I don’t know the exact reason for this, but very often you see that in these mega aortas there is a narrow zone just at that particular place. And in the one patient in whom this was not the case, we had to plicate the aneurysm. You can do this by making a longitudinal incision in the descending aneurysm and then do a repair, which means perform just a continuous transmural closure of the aneurysm in order to ree it. I think it is safer to reinforce this anastomosis with Teflon strips, because if you don’t do so and you have bleeding problems afterwards in this area, you will never be able to reach this region again and there might be a serious risk that the patient will bleed to death.

Dr S. La Francesca (Rome, Italy): I don’t know if I understood correctly, but you didn’t operate on 32 patients because you thought the diameter wasn’t large enough to operate on these patients? So you actually don’t do the elephant trunk procedure when you think you are going to do sure the second stage pretty soon? You actually wait. You kind of foresee the enlargement of the aneurysm and then again you wait and give the patient warfarin?

Dr Schepens: If I may correct you, we have even not operated upon 48 patients up to now, and I will tell you why. The basis of your question is, are we too liberal in implanting elephant trunks since in 50% of the cases, we didn’t perform the second step yet? The major advantage of the elephant trunk is that at the second procedure, you don’t have to dissect the hostile region of the left subclavian artery in which the left recurrent nerve is there, the vagus nerve is there, the anastomosis is there. So if you want to get into trouble, you should try to clamp the aortic arch. Because the morbidity and the mortality of isolated arch replacement compared to arch replacement plus elephant trunk is exactly the same in our hands, we are quite liberal in inserting an elephant trunk; because we think in advance that we will profit from it at the second stage. And that is the reason why we have done quite a number of elephant trunks and waited until the descending part of the aneurysm reaches a suitable diameter.

Dr La Francesca: Then I agree a hundred percent with that, but you do keep all patients on warfarin afterwards?

Dr Schepens: It is not my fault, but in the Netherlands there is an extensive use of warfarin; even if you have an appendicitis and you are 20, you risk to be put on a kind of anti-coagulation therapy when you are in the hospital.

Dr A. Haverich (Hannover, Germany): You said that you would absolutely discourage the audience in performing this operation in emergency and acute situations. There will be a poster presented this afternoon from our group where we did the David reconstruction combined with the total arch in 18 patients, and a number of them had also got elephant trunks. Once you are there with a total arch repair in acute aortic dissection, why not put in the elephant trunk to also facilitate late reoperation in, for instance, Marfan syndrome?

Dr Schepens: I think this is a very good question. In case of acute Type A aortic dissection, as you know, the friability of the tissues might cause serious problems. The primary goal of the repair is to save the life of the patient, and all kinds of variants of the operative technique, extensive or limited, have not shown much difference in outcome. I was the fool who performed the one elephant trunk in the acute Type A dissection, but I can assure you that I have been rather nervous during the intervention because the diameter was small and the tissues were very fragile. Introducing an elephant trunk into an acutely dissected aorta is therefore in my opinion asking for trouble. If it is a chronic dissection, this is totally different. But I agree, if you have a rupture of a degenerative aneurysm, probably it could be wise if you know in advance that the dilatation extends far into the descending part to implant an elephant trunk. That’s correct.