

Cardiac Surgery in Elderly Patients

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Objective. The morbimortality of elderly patients, (age 70 years or older), who underwent surgery for valvular and coronary artery disease in the last 17 years was analyzed.

Patients and method. A total of 1,305 patients (654 valvular, 531 coronary and 120 combined) operated from January 1985 to December 2000 were retrospectively studied. Mean age was 73.7 years. We analyzed the progression of the pathology, comorbidity, and results. A second retrospective analysis was made of patients who underwent surgery in the last three years (436 patients) to determine the relation between preoperative comorbidity and postoperative evolution.

Results. The mean hospital mortality was 16% (18% valvular, 11% coronary artery, and 23% combined). In the last three years this mortality was reduced to 11% (15.17, 6.26, and 16.18%, respectively) despite an increase in comorbidity. Comorbidity and complications increased with age ($p < 0.05$). Mean hospital stay was 15.5 days and the stay in intensive/semi-intensive care was 5 days. Independent risk factors of postoperative complications were creatinine levels > 2 mg/dl, combined surgery, and prior surgery. Predictors of death were prior surgery, valvular surgery, and combined surgery, with a clear tendency in the case of obesity. The presence of any complication in the postoperative period (renal or respiratory failure, infections, or myocardial infarction) was an independent predictor of mortality. Off-pump coronary surgery reduced mortality. In recent years, the mortality of patients operated without extracorporeal circulation has decreased from 5.71% to 4% for those who underwent extracorporeal circulation.

Conclusions. Nowadays, cardiac surgery in older patients accounts for more than 30% of our surgical activity. Mortality is being controlled although comorbidity is increasing. The difference with respect to younger people is due to comorbidity (creatinine > 2 mg/dl, combined surgery, and previous surgery) and the higher probability of complications (infections, renal, and respiratory complications), which worsens prognosis. We believe that off-pump coronary surgery helps to improve results.

Key words: Surgery. Aging. Morbidity. Prognosis.

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Cirugía cardíaca en el anciano

Objetivo. Analizamos la morbimortalidad en pacientes de más de 70 años intervenidos consecutivamente en los últimos 17 años.

Pacientes y método. Estudio retrospectivo de 1.305 pacientes (654 valvulares, 531 coronarios y 120 combinados) intervenidos entre enero de 1985 y diciembre de 2001, con una edad media de 73,7 años. Observamos la progresión de la enfermedad, la comorbilidad y los resultados. En los últimos 3 años (436 enfermos), relacionamos la enfermedad prequirúrgica y la evolución.

Resultados. La mortalidad media histórica fue del 16% (valvulares 18%, coronarios 11% y combinados 23%) y en los últimos 3 años del 11% (15,17, 6,26 y 16,18%, respectivamente), pese a una mayor comorbilidad. La presencia de comorbilidad y complicaciones se incrementó con la edad ($p < 0,05$). La estancia media en la unidad de críticos fue de 5 días, y la hospitalaria de 15,5 días. Los factores predictivos independientes de morbilidad fueron: insuficiencia renal previa, reintervención y cirugía combinada. Los factores predictivos independientes de mortalidad fueron: intervención previa, cirugía valvular y cirugía combinada frente a la coronaria, con una clara tendencia en la obesidad. La aparición de complicaciones en el postoperatorio (renal, respiratoria, infecciosa o IAM) fue un factor predictivo independiente de mortalidad. La cirugía sin circulación extracorpórea (CEC) ha supuesto una disminución de la mortalidad, siendo ésta en los últimos 2 años del 4 frente al 5,71% en pacientes coronarios con CEC.

Conclusiones. La cirugía cardíaca en pacientes de edad avanzada supera el 30% de nuestra actividad, con un aumento de la comorbilidad, aunque una mortalidad decreciente. La diferencia con el paciente joven radica en la comorbilidad (insuficiencia renal previa, intervención quirúrgica previa y cirugía combinada), y la mayor facilidad para presentar complicaciones (renales, respiratorias, infecciosas) que ensombrecerán el pronóstico. La cirugía coronaria sin CEC contribuirá a una mejora en los resultados.

Palabras clave: Cirugía. Geriátria. Morbilidad. Pronóstico.

Full English text available at: www.revespcardiol.org

ABBREVIATIONS

- CVA: cerebrovascular accident
- CPB: cardiopulmonary bypass
- COPD: chronic obstructive pulmonary disease
- AHT: arterial hypertension
- AMI: acute myocardial infarction
- CI: confidence interval
- OR: odds ratio
- NS: statistically non-significant
- NYHA: New York Heart Association
- CSPU: cardiac surgery postoperative unit

INTRODUCTION

The last few decades have seen a progressive aging of the population. Constant social and economic progress has lead to overall improvement in the quality of life. On the other hand, advances in the diagnostic and therapeutic fields have been accompanied by an important decrease in birth rate. All of these factors have contributed to this gradual social and demographic change.

If the expectations of the National Institute of Statistics prove to be true¹ (Figure 1), the population pyramid, which currently has a rhomboid morphology,



Fig. 1. Projected age pyramids for 2005 and 2020. Spanish National institute of Statistics (Instituto Nacional de Estadística, www.ine.es).

will become an inverted pyramid in the coming years. At the beginning of the last century, the population of persons over the age of 65 years in Spain barely reached one million inhabitants. In January 2001, this population surpassed 6 million inhabitants, constituting more than 16% of the population.

The main cause of morbidity and mortality in this population group is, by far,² cardiovascular disease. The number of older patients seen in our cardiovascular services who have a quality of life and increased expectations of longevity is growing without interruption.

We decided to make a retrospective observational study of our surgical activity over the last 17 years. The aim of the study was to evaluate the evolution and true position of cardiac surgery in elderly patients seen at a center affiliated with the Spanish national health system. We examined a wide range of ages (65 to 90 years), results, techniques, and national and institutional idiosyncrasies in more than 142 articles on the subject that we consulted, which were published between 1980 and 2001. Our center has performed cardiac surgery since 1972 and has performed a mean of 450 interventions per year with cardiopulmonary bypass (CPB). Consequently, its activity is in the upper limit for Spanish hospitals,³ which makes it a good example of the surgical activity in hospitals of the national health system.

We think that it is important to emphasize that our center is affiliated with the national health system and has patient population whose characteristics (and results) differ from those of private institutions.⁴ The hospital serves a district with more than 1.7 million inhabitants.

PATIENTS AND METHOD

Definitions

The data used in this study were collected from the department database (Patient Analysis and Tracking System, PATS; Axis Clinical Software). We analyzed the activity, characteristics, and results of surgery performed in patients with an age over 70 years who consecutively underwent coronary, valvular, and combined surgery between 1985 and 2001. Given the enormous advances that this type of surgery has experienced, as we will discuss below, for statistical purposes we created a subgroup that is more homogeneous and has more data, which included the patients who underwent surgery in the last 3 years (1999-2001). In turn, we compared this group with our patients who were younger than 70 years and underwent surgery in the same period.

We chose the cutoff age of 70 years arbitrarily, given the scant consensus regarding what patients are considered elderly for the effects of surgery. One of

the definitions of a geriatric patient that is accepted by the Spanish Society of Geriatrics and Gerontology (Sociedad Española de Geriátría y Gerontología) is that of a person more than 65 years in age with one or more diseases that tend to either chronicity or disability and whose evolution is conditioned by psychological or social factors.⁵ On the other hand, we did not wish to fall into the temptation of choosing a later cutoff age,⁶ considering that life expectancy in Spain is about 80 years.

The demographic data included age and sex. The medical history included the presence of risk factors (AHT, diabetes, chronic respiratory disease, kidney failure, history of central or peripheral embolism, abdominal and peripheral vascular disease) and other concomitant disorders (all defined by the cardiologist who diagnosed the patient). The cardiological history included the functional class (NYHA), number of coronary arteries with significant lesions, and the presence, grade, and type of cardiac valve disease. In the postoperative period we analyzed the presence of kidney or respiratory failure, AMI, infection, sternal dehiscence, cerebrovascular accident (CVA), and reoperation for hemorrhage. The number of days in the cardiac surgery postoperative unit (CSPU) and the total hospital stay were recorded.

Kidney failure was defined as creatinine values >2 mg/dL and mortality was defined as death that occurred before patient discharge or, after discharge, within 30 days of surgery.

Surgical technique

Most patients underwent surgery with standard CPB techniques. The myocardium was preserved with cold blood antegrade cardioplegia and warm reinfusion. The routine use of aprotinin in patients has increased since 1992. In the last 3 years we have tended to per-

form coronary surgery without CPB, as is presently done in more than 45% of all our revascularization procedures. Changes have also been made toward using anesthetic techniques that favor early extubation of the patient.

Statistical analysis

The results have been expressed as simple arithmetic means for continuous variables and as percentages for the dichotomic variables. Variables expressed as percentages were compared by χ^2 analysis. Logistic regression analysis was used to study the factors predictive of postoperative complications (understood as the appearance in the postoperative period of kidney failure, respiratory failure, infection, or CVA) and mortality, in spite of being a retrospective study with the statistical limitations inherent to such studies.

Study sample

From 1 January 1985 to 31 December 2001, a total of 1305 patients over 70 years old (range, 70-86 years) underwent cardiac surgery in our center. The mean age was 73.7 ± 1.2 years. A total of 654 patients (50.1%) underwent surgery for valve disease, 531 for coronary disease (41.6%), and 120 patients (9.1%) underwent combined surgery (valve and coronary). Patients with other disorders (pericardial, aortic, etc) were excluded in order to obtain large enough groups to draw statistically significant conclusions.

RESULTS

Historical study

In 1985, surgical activity in older patients was anecdotal, being limited to 6 patients (1.7% of all activity

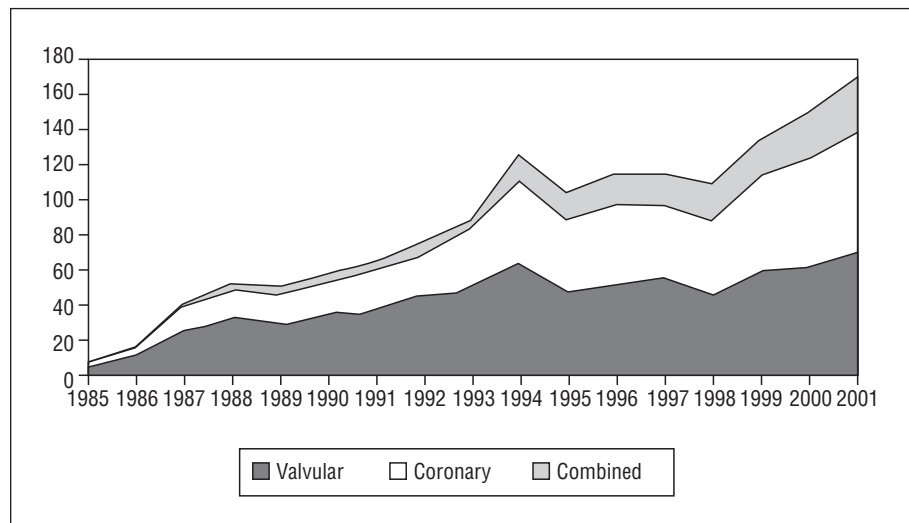


Fig. 2. Evolution of surgery in patients over 70 years in the last 16 years.

that year). In 2001, the total number rose to 168 patients, which was 32% of our total surgical activity (Figure 2).

There was no significant difference in age between coronary and cardiac valve patients: 73.73 years for valve surgery and 73.72 years for coronary surgery.

If we observe the evolution of surgical disease, it is evident that cardiac valve disease has been the historical basis of this group. Until 1993, valve disease was involved in 64% to 77% (in 1989) of surgical indications. In the last 7 years we have observed that coronary disease has gained terrain, currently surpassing 45.4%. Combined surgery is also increasing, although more discretely.

In the group of valve surgery, the valve most frequently affected was the aortic valve (61.6%). Mitral disease is a distant second (18.9%) and mitroaortic disease follows (19.5%). With regard to the type of valvular lesions that were an indication for surgery, stenosis was the main condition in patients with aortic disease (90.3%), whereas incompetence was the major indication for surgery in patients with mitral disease (61%).

In patients with coronary disease, the mean number of grafts used per patient was 2.65 for disease of 2.88 vessels. In patients with combined surgery, the mean number of vessels revascularized was 1.84 for disease of 1.97 vessels.

We compared these patients with other patients treated for the same disease who were younger than 70 years. Altogether, underlying diseases were more frequent in the patients over 70 years (Figure 3). The presence of kidney failure increased linearly. Chronic obstructive pulmonary disease (COPD) and diabetes were clearly more frequent in the group of 70 to 75-year-old patients (23.1% vs 29.9%, respectively) compared with the patients younger than 70 years who

were operated on (15.9% vs 13.8%). This tendency was not observed in peripheral vascular disease (<70 years, 13.7%; 70-75 years, 13%, and >75 years, 14.1%).

Substratification by the underlying disease showed that patients with coronary artery disease presented the greatest comorbidity ($P<.05$). Thus, the most frequent concomitant diseases in coronary patients were COPD (36.1%), AHT (30.1%), diabetes (28.2%), CVA (14.9%), kidney failure (12.3%), peripheral vascular disease (16.9%), and others - digestive, urological, gynecological, etc -- (23.9%). Angina pectoris was type IV (at the time of the indication) in 32.9% of cases. In the group of patients with valve disease, the most frequent conditions were COPD (26%), AHT (19.4%), CVA (15.1%), diabetes (14.7%), kidney failure (13.8%), and other disorders (14.1%). The mean functional grade was 2.7. On the other hand, the slope of the increase in this preoperative comorbidity was greater than the slope of growth of the total volume of patients (data not shown due to non-significance).

Almost all of the postoperative complications of these patients also increased linearly with age (Figure 4). Data are not shown because the 1999-2001 study was more exhaustive.

Mortality has shown a descendent curve over the years. Thus, mean mortality in patients with valve disease was 25% in 1985-1990, 20% in 1991-1995, and 13.3% in 1996-2001. In the patients with coronary surgery, the corresponding mortality rates were 20%, 15%, and 6.9%, respectively. The apparently divergent ratio of mortality due to valvular/coronary surgery (1.2, 1.3, and 1.9, respectively) reflects the decline in mortality in coronary patients in recent years.

The mean hospital stay in valvular surgery patients was 14.1 days and in coronary surgery patients, 14.8

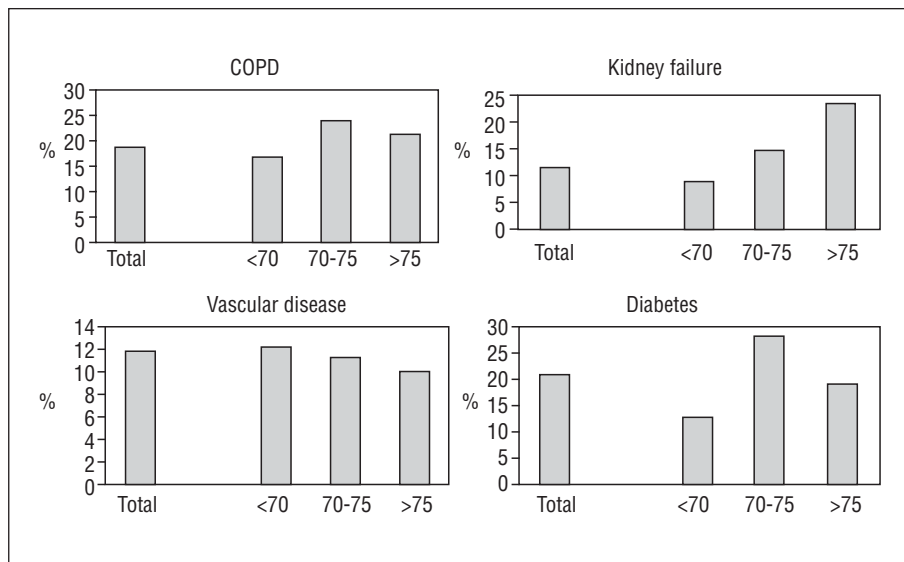


Fig. 3. Preoperative comorbidity by age in patients who underwent surgery between 1995 and 2001.

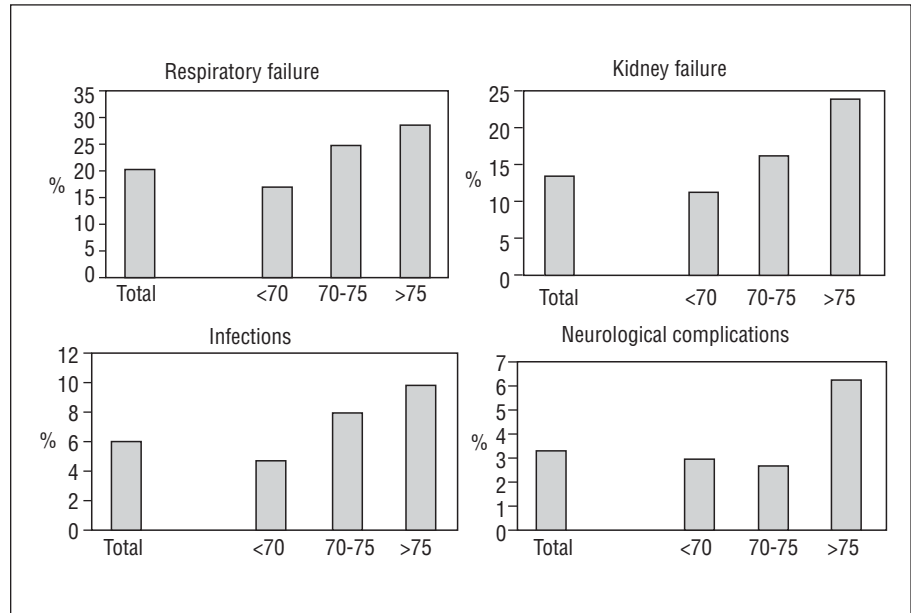


Fig. 4. Postoperative complications by age in patients who underwent surgery between 1995 and 2001.

days, which did not differ significantly (NS). On the other hand, the CSPU stay of both groups was 4.9 days (NS). Except for the total hospital stay of the coronary group, the tendency of the other stays showed no change: hospital stays have been prolonged and are still prolonged.

1999-2001 study

The subgroup of patients composed of patients over 70 years who underwent surgery between 1999 and 2001 consisted of 436 patients. Coronary surgery was performed in 43.58%, (26.4% without CPB), valvular surgery in 44.83% (aortic, 54.2%; mitral, 20.3%, and 25.4%, mitral-aortic), and combined surgery in 15.6%. The mean age was 73.97 years, with no significant differences by disease. The group had 37.4% women.

The clinical characteristics of the subgroup are described in Tables 1 and 2.

Patients 70 to 75 years old were 60.5% of the group, patients 75 to 80 years old were 35.3%, and patients over 80 years were 4.2%.

In the comparison of this subgroup with the patients under 70 years who underwent surgery in the same period for the same diseases, underlying disease was more frequent in patients over 70 years (Table 3).

Bivariate analysis of the overall subgroup of 70 to 75-year-old patients and patients over 75 years did not reveal any statistically significant difference between groups in the occurrence of complications or mortality.

Analysis of the preoperative characteristics in relation to the occurrence of complications disclosed significant differences between the types of heart disease treated (25.2% coronary, 34.8% valvular, and 42.6%

TABLE 1. Preoperative characteristics of the 1999-2001 subgroup of patients over 70 years

| | Overall | Coronary | Valvular | Combined |
|------------------|---------|----------|----------|----------|
| Total | 100% | 43.5% | 44.8% | 15.6% |
| Mean age, years | 73.9 | 73.5 | 73.9 | 75.05 |
| Sex, women | 37.4% | 22.2% | 57.3% | 27.9% |
| Obesity | 4.3% | 5.2% | 3.9% | 2.9% |
| COPD | 22.7% | 23.1% | 22.4% | 22.1% |
| AHT | 12.1% | 18.9% | 7.3% | 7.3% |
| Vascular disease | 14.9% | 22.7% | 10.5% | 14.7% |
| Diabetes | 26.1% | 33.1% | 20.7% | 22.1% |
| CVA | 10.9% | 11.6% | 9.8% | 10.3% |
| Kidney failure | 18.1% | 17.4% | 19.1% | 20.6% |
| Previous surgery | 7.1% | 5.2% | 9.5% | 5.9% |

COPD indicates chronic obstructive pulmonary disease; AHT, arterial hypertension; CVA, preoperative cerebrovascular accident.

TABLE 2. 1999-2001 subgroup of patients. Postoperative complications

| | Overall | Coronary | Valvular | Combined |
|----------------------|---------|----------|----------|----------|
| Mortality | 11.01% | 5.26% | 15.17% | 16.18% |
| Total complications* | 31.8% | 25.2% | 34.8% | 42.6% |
| Respiratory failure | 22.7% | 17.3% | 25.3% | 30.8% |
| Kidney failure | 16.9% | 12.7% | 20.8% | 25.0% |
| Infections | 8.2% | 8.1% | 6.7% | 13.2% |
| CVA | 3.9% | 4.7% | 2.8% | 4.4% |
| Reoperation | 4.8% | 3.2% | 6.2% | 5.8% |
| Sternal dehiscence | 1.3% | 1.5% | 1.1% | 1.5% |

*Appearance of a complication (respiratory or kidney failure, infection, CVA, sternal dehiscence, or reoperation) in the postoperative period. CVA indicates postoperative cerebrovascular accident.

TABLE 3. Preoperative and postoperative morbidity by disease and age

| | Coronary (%) | | | | Valvular (%) | | | | Overall (%)* |
|-----------------------------------|--------------|-------------|-----------|------|--------------|-------------|-----------|------|--------------|
| | <70 years | 70-75 years | >75 years | P** | <70 years | 70-75 years | >75 years | P** | |
| COPD | 18.9 | 25.4 | 17.3 | .28 | 14.6 | 20.7 | 25.9 | .05 | 18.5 |
| Dyslipidemia | 10.7 | 10.5 | 21.1 | .08 | 2.7 | 4.9 | 5.5 | .24 | 7.5 |
| Diabetes | 28.5 | 30.7 | 36.5 | .44 | 7.2 | 25.6 | 16.6 | <.01 | 20.7 |
| AHT | 7.1 | 17.5 | 23.1 | <.01 | 6.9 | 5.9 | 9.2 | .57 | 8.8 |
| Vascular disease | 21.2 | 20.2 | 27.3 | .21 | 5.6 | 10.1 | 10.7 | .03 | 11.8 |
| Kidney failure (creatinine >2) | 6.6 | 16.1 | 19.2 | <.01 | 8.7 | 13.8 | 25.8 | .04 | 10.6 |
| Preoperative VA | 6.5 | 14.9 | 6.7 | .02 | 10.4 | 10.9 | 8.7 | .72 | 9.1 |
| Postoperative respiratory failure | 15.3 | 16.5 | 19.2 | .63 | 15.1 | 18.8 | 31.5 | .01 | 16.7 |
| Postoperative kidney failure | 5.8 | 12.2 | 13.6 | .04 | 13.1 | 16.8 | 24.1 | .05 | 11.1 |
| Reoperation | 2.4 | 2.6 | 3.8 | .75 | 4.9 | 3.9 | 9.2 | .33 | 3.8 |
| Postoperative infection | 3.9 | 9.6 | 7.6 | .03 | 4.2 | 2.9 | 11.1 | <.05 | 5 |
| Postoperative CVA | 1.4 | 4.2 | 5.7 | .02 | 4.5 | 1.9 | 3.7 | .58 | 3.2 |
| Mortality | 4.1 | 5.1 | 6.0 | .17 | 6.1 | 12.8 | 20.3 | <.01 | 6.7 |

*Rates of comorbidity and complications in the overall group of patients who underwent surgery between 1999 and 2001. **Comparison of the rate of comorbidity and complications between different age groups. CVA indicates cerebrovascular accident.

combined; $P=.017$), previous intervention (51.6% vs 30.3%; $P=.014$), and previous kidney failure (60% vs 26.5%; $P<.001$). Multivariate study confirmed these findings and showed that they were independent factors (Table 4). Previous COPD tended to be more frequent (38.4% vs 29.9%; $P=.09$). In multivariate analysis, female sex and previous surgery tended to be more frequent. In the subgroup of coronary surgery patients, we only observed significant differences in the presence of previous kidney failure (42% vs 22%; $P=0.020$). In the subgroup of valvular surgery patients, the presence of COPD (50% vs 30.4%; $P=.022$) and previous kidney failure (68% vs 29.4%; $P=.001$) were significant. In the last subgroup, single-valve versus double-valve surgery clearly tended to significance. In the patients with combined surgery, significant differences were seen in patients with AHT (98% vs 38%; $P=.007$) and previous kidney failure (85.7% vs 31.4%; $P<.001$), as well as a clear tendency to obesity, previous intervention, and previous CVA. In multivariate

analysis, only the presence of previous kidney failure was significant (in all subgroups, coronary, valvular, and combined surgery) (Table 4).

Analysis of the preoperative characteristics with respect to mortality has revealed significant differences only in women (14.8% vs 8.4%; $P=.041$), type of heart disease treated (coronary 5.26%, valvular 15.17%, and combined 16.1%; $P=.003$), and previous intervention (32.2% vs 9.3%; $P<.001$). A tendency was found for obesity (21% vs 10.5%; $P=NS$). Multivariate analysis confirmed these results, although the effect of female sex was not statistically significant. We observed a tendency in patients with COPD (Table 5). In the subgroup of coronary surgery patients, only the presence of previous kidney failure was statistically significant (12.9% vs 3.7%; $P=.037$). We found no significant differences in the subgroup of valvular surgery patients, but we did observe a tendency for previous intervention (29.4% vs 13.6%; $P=NS$) in the group of mitral incompetence. In the patients who underwent combi-

TABLE 4. Independent predictors of morbidity in logistical regression analysis of patients who underwent surgery in 1999-2001*

| | OR | P | 95% CI |
|-------------------------|--------|-------|---------------|
| Age, years | 0.9817 | .613 | 0.9141-1.0543 |
| Women | 1.5202 | .086 | 0.9420-2.4535 |
| Valve/coronary surgery | 1.4930 | .121 | 0.8997-2.4773 |
| Valve+coronary/coronary | 2.2658 | .010 | 1.2182-4.2143 |
| COPD | 1.4742 | .132 | 0.8893-2.4436 |
| Kidney failure | 4.5342 | <.001 | 2.5853-7.9522 |
| Reintervention | 2.2627 | .039 | 1.0425-4.9110 |

*Probability $>\chi^2=0.0000$. OR indicates odds ratio; CI: confidence interval

TABLE 5. Independent predictors of mortality in logistical regression analysis in patients who underwent surgery in 1999-2001

| | OR | P | 95% CI |
|-----------------------------|---------|-------|-----------------|
| Age, years | 1.0476 | .162 | 0.9714-1.1896 |
| Women | 1.5720 | .191 | 0.7981-3.0963 |
| Valve/coronary surgery | 2.9625 | .011 | 1.2775-6.8702 |
| Valve+coronary/coronary | 3.6917 | .008 | 1.4001-9.7336 |
| Obesity | 2.8929 | .058 | 0.8629-9.6984 |
| COPD | 1.4457 | .323 | 0.6963-3.0015 |
| Reoperation | 4.9567 | <.001 | 2.0663-11.8904 |
| Coronary+valve subgroup | | | |
| Mi/Ao | 6.8873 | .062 | 0.9055-52.3812 |
| Mi+Ao/Ao | 20.6617 | .004 | 2.5649-166.4405 |
| Postoperative complications | | | |
| Respiratory failure | 3.866 | .004 | 1.5461-9.6676 |
| Kidney failure | 8.462 | <.001 | 3.0410-23.5505 |
| Infection | 10.602 | <.001 | 3.1294-35.9183 |
| AMI | 3.197 | .010 | 1.3118-7.7884 |
| CVA | 1.293 | .739 | 0.2845-5.8838 |

*Probability $>\chi^2=0.0001$; OR indicates odds ratio; CI, confidence interval

ned surgery, there were significant differences in patients with mitral valve disease (30% vs 4.5%; $P=.006$) and previous surgery (98% vs 10.9%; $P<.001$). In addition, there was a clear tendency toward female sex, obesity, and AHT. Multivariate analysis showed the same tendencies, but they did not reach statistical significance.

The addition of postoperative complications as predictors of mortality to multivariate analysis of the overall group (OR=0.44; $P<.0001$) showed that kidney failure, respiratory failure, infarction, and postoperative infection were strong independent predictive factors of mortality.

We also analyzed the final cause of death in the patients who passed away. In the overall group of patients undergoing surgery (younger and older than 70 years), cardiogenic shock was the main cause of death, followed by infectious causes, as was also seen in the 70 to 75-year-old group. Nevertheless, in patients over 75 years there was a spectacular increase in multiple

organ failure that surpassed cardiac causes in frequency (37% vs 30%). This cause of death had scant relevance in the groups of patients under 75 years ($P<.001$).

In the subgroup of coronary patients we would like to emphasize the 62 patients who underwent surgery in the last two years without CPB, in which the rate of complications and mortality (4%) decreased significantly.

The mean CSPU stay was 3.2 days in the patients under 70 years, 3.9 days in the 70 to 75-year-old patients, and 5 days in patients over 75 years. This has hardly changed in 17 years of follow-up. The subgroup of coronary patients who underwent surgery without CPB showed a certain mean decrease, with CSPU stays of 2.93 days and hospital stays of 9.32 days.

Follow-up 45 days after discharge of the patients who underwent surgery from 1985 to 2001 was achieved in 98.1% and revealed the survival of 85.92% of

the coronary surgery patients. Follow-up was achieved in 97.8% and survival was 78.5% in the case of valvular surgery patients. In the case of coronary surgery, 92.7% of the patients were free of symptoms. In the case of valve surgery, the functional grade improved appreciably.^{1,6} Nonetheless, the number of readmissions (in the first 2 months) for heart failure was 9.1%.

DISCUSSION

The progressive aging of the community is reflected in the age of the patients seen at our centers. Currently, patients older than 70 years already are responsible for more than 32% of our total surgical activity and it is to be assumed that they will continue to increase in view of the progression seen in these years.⁷ We also think that it is necessary to inform the community about this trend, of which health-care professionals are generally unaware.⁸

Our findings and results confirm those of other publications of national scope,⁹⁻¹¹ in contrast with some much more optimistic studies¹²⁻¹⁵ from countries with very different characteristics in terms of patients,¹⁶ centers, and the equipment of centers. We think that it is important to draw attention to our reference population, as our hospital is affiliated with the national health system.⁴

In recent years we have appreciated a decrease in surgical mortality among patients of advanced age, with a higher ratio than in younger patients. This indicates that the mortality of this group was more susceptible to improvement. With regard to the condition that was treated surgically, there was more improvement in the results obtained in patients with coronary disease compared with valvular disease due, among other factors, to surgery without CPB.

Valve surgery is the traditional mainstay of cardiac surgery (we should not forget that most aortic valve patients are older than 65 years). Although apparently less demanding technically, it is characterized by a greater morbidity and mortality. At present, valvular surgery is being equaled in volume by coronary surgery (currently 45.4%). Like other authors,¹⁷ we think that it is erroneous to reserve cardiac surgery for older patients with valve disease, especially since better results were obtained in coronary surgery without CPB (mortality 4%) than in valve surgery (15.17%).

On the other hand, an increment, although more gradual, was also observed in the use of combined surgery. We believe that combined procedures versus isolated surgical procedures will be even more common in the coming years.

Currently, most patients of advanced age are 70 to 75 years old (mean age, 73.7 years). However, in the coming years there will be a progressive shift towards even older patients,¹⁵ due, in our opinion, to the improvement in results and a reduction of waiting lists.¹⁸ For

this reason we decided not to include the criterion of urgency in our study, given the ample variability of this concept in relation to waiting lists and other considerations of each center (in the literature reviewed, the percentage of patients who underwent emergency surgery ranged from 12% to 94%).

Likewise, we did not include in our study the effect of CPB and ischemia time¹¹ on elderly patients. In our experience, these times do not vary (and may even be shorter) with respect to patients under the age of 70 years and cannot foreseeably be controlled by surgeons (in every case, the surgeon will try to shorten them). We agree with other authors^{11,19,20} that longer CPB and ischemia times are accompanied by a less favorable prognosis in any surgical patient, particularly in patients of advanced age undergoing myocardial surgery,²¹ which encourages us to favor surgery without CPB.

With respect to functional capacity, we evidently agree that the greater the functional impairment^{11-13,22} at the time of surgery, the worse the prognosis will be.

The factors commonly associated with greater mortality, like ventricular dysfunction or more complex surgical procedures, have been shown to be associated with a less favorable prognosis, although no more than in younger patients, which is why they were not included in our tables.

Preoperative comorbidity, postoperative complications, and mortality increase with age. However, we believe that the weight of this contingency basically lies in the accumulated comorbidity. The major difference with respect to younger patients lies in the comorbidity, which, in addition, is usually multiple.^{13,14,18} Comorbidity determines a biological age that does not always correspond with chronological age. Ultimately, it favors the appearance of complications in the postoperative period and, in the worst case, mortality.

We have observed that all the comorbidity factors (diabetes, COPD, AHT, kidney failure, and CVA) tended to increase with age, except vascular disease (although not in coronary surgery patients). This finding is probably due to a certain negative discrimination in patients with vascular disease compared with other comorbidities in the case of patients with valve disease.

Our experience coincides with the results of most publications.^{9-15,23} We found that the presence of previous kidney failure, previous surgery, and the type of heart disease treated, with preference for valve surgery and combined procedures, showed a statistically significant tendency toward the occurrence of postoperative complications. In the subgroup of patients with valve surgery, the degree of pulmonary involvement also worsened the prognosis.

Female sex, previous surgery, and the heart disease treated (also with preference for valve surgery and combined procedures) were found to be factors related to mortality. Substratification by disease revealed that

the presence of COPD favored the occurrence of complications in patients who underwent valvular and combined procedures.

As independent predictive factors for the appearance of complications, we found kidney failure, previous surgery, and combined surgery, as well as a clear tendency toward female sex.

The independent predictive factors of mortality were previous surgery and valvular and combined surgery versus coronary surgery. In the substratification by disease, mitral aortic valve disease was found to be a strong predictor. Pure mitral valve disease versus pure aortic disease was also a predictor of mortality.

We introduced postoperative complications in the regression analysis and found that the appearance of any major complication in the early postoperative period was predictive of mortality: kidney failure, respiratory failure, AMI, or infection. This underlines the importance of preventing these complications in the course of surgery.

CVA (preoperative or postoperative) has not been shown to be a factor predictive of mortality. However, the greater prevalence of postoperative CVA in coronary patients shows that the frequency of appearance is greater in patients with vascular disease, which confirms that the degree of mobilization and instrumental manipulation of the pathological ascending aorta during surgery is a major cause of CVA.

In relation to the clear tendency to multiple organ failure in older patients, we think that it exemplifies the scant biological reserve of some fragile older persons,⁴ which we should learn to identify. This, in the presence of a complication, easily leads to multiple organ failure due to the paucity of their physiological resources.

Finally, we think that it is very important to emphasize that the hospital stay^{11,23} is a parameter that has hardly changed in the last 16 years. Historically, the mean hospital stay has been 15 days and the CSPU stay, 5 days. In the last 3 years, the hospital and CSPU stays have been 13.8 days and 4.2 days, respectively. This finding caused us to reflect that if we want to increase our surgical activity, semi-intensive care units will have to be created to avoid collapsing our intensive care units. On the other hand, the transfer of these patients to another care level (convalescent units or day hospitals) where patients of advanced age are ensured allow a better and more complete recovery should be suitable.

The immediate follow-up period (which should be treated in detail in another paper) was optimal, demonstrating that once the acute phase has passed, the patient recovers his or her baseline state, although more slowly than younger patients, and shows a great improvement in quality of life. However, some patients with valve disease continue to consult for late diagnoses or indications, which greatly darkens their

prognosis.

CONCLUSIONS

Cardiac surgery in patients of advanced age has ceased to be exceptional and now exceeds 30% of our activity, with an increase in concomitant disease and a decrease in mortality. The bulk of these patients are still between 70 and 75 years.

The fundamental difference between older and younger patients lies basically in their comorbidity (in our experience, kidney failure and previous surgery), underlying heart disease (valve surgery and combined surgery), and in the greater predisposition to complications (renal, respiratory, or infectious), which clearly worsen prognosis. We believe that coronary surgery without CPB will help to drastically improve results.

The correct overall evaluation and preparation of a geriatric patient before surgery, as well as constant technical improvements, are making it possible to achieve favorable surgical results with an acceptable morbidity and mortality.

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