

# Does Nature of Hospital Financing Influence Early Mortality After Coronary Artery Bypass Grafting

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The aim of public health systems is to ensure that patients receive effective and efficient health care within a reasonable period. In Spain, running of the health care system has recently been transferred to the autonomous regions. Most of these regions have sufficient infrastructure to cover the needs of their population for the most common cardiovascular diseases such as ischemic heart disease. However, some health systems still refer a variable number of their patients to hospitals in the private sector, either referring patients for certain specialties to a private center or referring patients directly from waiting lists for public hospitals. The reasons for such referrals are usually excessive time spent on the waiting list or certain shortcomings in the number or facilities of public hospitals in certain regions.

Comparison of the cost and the outcomes of care processes in public and private hospitals has always been subject to controversy. This comparison is fully justified, and indeed is an obligation when the public health service finances operations in private hospitals. In an article in this issue of the journal, Ribera et al<sup>1</sup> publish the results of a study financed by the Catalan public health system. The study compared early mortality after coronary artery bypass grafting (CABG) in patients from the public health system who underwent operations in both public and private hospitals. They then compared the results with those of a similar study published 6 years ago.<sup>2</sup> Although the objective is worthy of praise, objective comparison between the public and private sectors for outcomes is difficult because substantial structural and functional differences exist between the 2 systems and these differences effect to a greater or lesser extent the individual outcomes of the health care.

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## Differences Between Public and Private Centers

### *Teaching*

Most public centers that practice heart surgery are involved in teaching. It is essential to have centers in which trainee surgeons carry out operations of increasing complexity, always under the supervision of an experienced surgeon. Trainee surgeons usually perform less complex procedures in patients with a low risk profile, and so the fact that they are in training should not be associated with a greater risk. University hospitals have been shown to have a lower absolute mortality than nonuniversity hospitals and a similar risk-adjusted mortality.<sup>3</sup> This tendency has also been confirmed for the most demanding techniques, such as CABG without extracorporeal circulation, even in patients at high risk.<sup>4</sup> University hospitals are also more receptive to new technology and are usually focussed on certain technically more complex procedures or procedures that require particularly expensive resources.

### *Human Resources and the Number of Operations per Surgeon and Center*

Public hospitals have sufficient staff to guarantee coverage in different specialist care at any time, but with such coverage, the operations are necessarily spread more thinly. In contrast, most private centers usually have only 1 or 2 surgeons on their payroll who do all the operations although, often, they also work at other centers. All studies done to date agree that the experience of the center and the surgeon is of great importance for the outcome of coronary surgery.<sup>5,6</sup> Evidently, there is an inverse relationship between the number of operations and operative mortality, although a threshold below which the risk of the procedure becomes unacceptable is not clearly defined. Most studies concur that a surgeon should perform between 100 and 125 operations per year to optimize outcomes, although mortality only increases markedly when the number of operations per year drops below 50.

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The number of operations per center is also an important variable and one that is related to the experience of the surgeon. Operative mortality is reduced even more sharply in centers that perform more than 300 CABG per year, and at twice this number the decrease is substantial. However, in 1 of the biggest registries, that of the Society of Thoracic Surgeons,<sup>7</sup> the relationship between the number of interventions per center and early mortality, although statistically significant because of the large sample size, is relatively small (odds ratio =0.98) and only affects the group of patients at moderate or high risk. Nevertheless, most studies show considerable variation in outcomes in different centers, particularly for those that perform a limited number of operations. Therefore extreme caution should be taken when choosing centers or surgeons according to the number of operations. In the article by Ribera et al,<sup>1</sup> this aspect seems to be treated as a sideline, and they do not provide any data on the number of operations per surgeon and only indicate the number of operations by center in the 2 years of the study. The number of operations per surgeon and per year does not appear in the table that presents the independent determinants of mortality, although the text then affirms that this is a variable associated with longer survival. Only in an a posteriori analysis did the authors investigate what effect it would have on a previously constructed model to predict risk. They found that inclusion in model contributed to a reduction in the influence of whether the center was in the public or private sector.

### *Specialization*

Given the sophisticated techniques demanded by CABG, it might be assumed that such procedures could be done more efficiently in centers dedicated specifically or mainly to this type of intervention. Such specialization is more common in private centers, and this is reflected by the study. However, some large public centers in Spain have multidisciplinary units made up of different specialists who bring together knowledge of techniques for the treatment of cardiovascular disease with excellent results. These clinical units, developed in large general hospitals, offer highly specialized care and can also benefit from the extensive resources not available to smaller centers. In addition, specialized centers focus their entire activity on cardiovascular interventions only and are less likely to admit patients with concurrent diseases. In agreement with the larger number of procedures and the profile of lower risk in the population they care for, the specialized centers usually have a lower absolute mortality. However, this difference disappears when the mortality is adjusted by number of operations and risk profile of the patients.<sup>8</sup>

### *Differences in the Clinical Characteristics of the Population*

Because the public and private health care sectors are different in nature, they usually accept patients with markedly different risk profiles. Given the public sector is universal whereas the private sector is selective and for profit, socioeconomic, demographic, and clinical characteristics will vary according to the sector. In the ARCA study,<sup>1</sup> patients in the private sector had a higher risk profile. However, the differences are limited almost exclusively to variables associated with a more unstable clinical condition at the time of surgery, such as a greater deterioration in functional status, angina in the 48 hours prior to the operation, the need to use intravenous nitrates at the start of surgery, and the critical preoperative condition. All these circumstances were more frequent in patients who underwent surgery in private centers. It is not clear why this is, and the differences cannot be explained by anatomical differences even if anatomical characteristics and clinical condition are not necessarily related. Perhaps a more likely explanation is differences in perioperative treatment strategies.

### *Differences in the Care Process*

In general, the delay until surgery is usually shorter in private hospitals, and this is reflected in the ARCA study.<sup>1</sup> Given that private hospitals have greater opportunity to act sooner this "might have led to earlier operations on unstable patients." The rationale behind this strategy, which in itself increases the surgical risk, is not clear in the article and runs contrary to clinical guidelines, which recommended postponing surgery and intensifying pharmacological treatment or even resorting to intraaortic balloon angioplasty if pharmacological treatment fails.<sup>9,10</sup> The ARCA study<sup>1</sup> makes no reference to how many patients, if any, underwent such a procedure.

In addition, the need for emergency and emergent surgery was high in both types of center, but particularly in private centers, where 2 out of every 3 patients underwent nonelective surgery. This is at odds with the experience of other Spanish groups. In a recent publication that studied the characteristics of the population who underwent CABG in a region close to Catalonia, García Fuster et al<sup>11</sup> found that only 21.6% of the patients required emergency surgery, defined as the need to operate during the same stay in hospital. These findings are in full agreement with our experience in a completely different region and with patients with a different socioeconomic status. Moreover, analysis of this fact is made more difficult because 2 types of operation, emergency and emergent, which entail very different risks, have been studied. Better clarification would have been obtained

by breaking down this subgroup according to the prioritization criteria drawn up jointly by the Spanish Society of Cardiology and the Spanish Society for Cardiovascular and Thoracic Surgery.<sup>12</sup>

There are also significant differences in the complexity of the surgical technique used. Thus, 25% of the patients who underwent the operation in a public hospital benefitted from surgery in more than 1 vessel compared to only 3% of those whose operation was in a private hospital. Likewise, CABG without extracorporeal circulation accounted for half the operations in public hospitals compared to 22% of those in private hospitals, a difference which might explain the longer postoperative stay. These figures reflect a stronger commitment on the part of public hospitals to use techniques that reduce early mortality and improve long-term clinical outcomes.

### How to Compare Quality of Health Care

Anyone who sets out to compare the quality of care offered by the different types of health system or even by different hospitals must define the indicators to be studied and the methodology to be followed. Many indicators of quality of health care can be analyzed. Early mortality, whether in hospital or, preferably, in the first 30 days, is the most widely used indicator because of its overriding clinical importance and its easy application. However, many factors can affect this variable; therefore adjustments are necessary to account for the characteristics of the patients admitted to each hospital. These include adjustments for the characteristics of the population attended (case-mix), for those of the health care process, and for those of the hospital providing the care. The latter of these factors include whether the hospital is a general or specialist one, the number of beds, whether it is a university hospital, and the type of financing.

There are different scales for predicting the surgical risk of CABG. Whatever scale is used, it must have been validated beforehand in the different types of health care before using it as a comparative tool. The EuroScore is the risk scale most widely used in Spain and it has been exhaustively validated in different settings and countries with excellent results.<sup>13</sup> In contrast, the scale developed by the *Agència d'Avaluació de Tecnologia i Recerca Mèdiques* (AATRM) has not been validated in other settings or compared with other risk models. Furthermore, the clear tendency shown in the ARCA study<sup>1</sup> to overestimate risk weakens any conclusions that can be drawn from its use. The overestimation of risk is not surprising given that this scale was developed in almost the same centers that participated in this study and indicates that the model that was developed years ago is not valid today. Nevertheless, we must accept that any risk scale has its limitations when used to

compare the case-mix and mortality in different hospitals, especially if they belong to different sectors. These scales do not take into account, for example, the possibility that there are differences in the indications for surgery or when it was performed.

Furthermore, some centers with excessive patient selection and those that oversimplify their surgical procedures may benefit from limiting the assessment of quality of health care to early mortality. Other indicators of quality exist that analyze technical aspects such as the incidence of complications and resources consumed, particularly during the patient's stay in hospital. Among indicators based on complications are the number of grafts, which reflects the quality of revascularization; the vessels treated; and whether or not extracorporeal circulation is used. The prevalence of certain complications, in particular perioperative myocardial infarction, neurological complications, renal failure, surgical wound infection, and repeat operations due to bleeding are also indicators of the quality of health care which can be easily derived from medical records.<sup>14</sup> Finally, other aspects that can also be readily obtained and compared are delay in surgery, length of stay in the intensive care unit (ICU) and in hospital, and the need for readmission due to complications derived from the operation. In the ARCA study,<sup>1</sup> most of these indicators point to better quality of health care in hospitals belonging to the public sector.

### Repercussions of Publishing Comparative Results

The dissemination of figures for CABG mortality in other settings, such as for example New York State, have been associated, as is the case in Catalonia, with a clear improvement in outcomes and a decrease in the influence of number of operations per surgeon and center. This improvement usually occurs at the expense of centers or surgeons with worse outcomes. As a result, the most recent studies show a greater uniformity in CABG outcomes, such that the difference between mortality adjusted for risk in the centers with a low throughput of patients undergoing surgery and those with a high throughput has decreased considerably.<sup>14</sup> The reasons for the beneficial effect of public dissemination of the outcomes, seen regardless of whether the centers are identified or anonymous, are less clear. Some suggest that patients with highest risk are referred by the cardiologist to certain centers of excellence or that these patients themselves prefer treatment in such hospitals. Others attribute it to specific measures taken to improve the quality of health care as a result of greater awareness of the problem. Still others think that cardiologists and patients are immune to this information and prefer to trust the reputation of the center or prefer to undergo the operation in a hospital

near to them. Some even maintain that the decrease in mortality cannot be attributed to the publication of the results.

## Final Comment

The strongest message from the ARCA study, though transmitted in an attenuated form by the investigators, is that whether the hospital is in the public or private sector has an independent influence on CABG mortality in Catalonia, and that private centers have achieved a lower mortality than expected. This affirmation contrasts with the lack of significant differences in the figures for absolute mortality and mortality adjusted according to 2 risk scales between the 2 types of center, indicating the possible influence of factors not analyzed in the statistical model. Furthermore, the ARCA study did not include 2 of the public hospitals in Catalonia with the largest number of operations. Inclusion of these centers might have altered the conclusions of the study. As the authors themselves concede, the type of management affects both the characteristics of the patients treated and the individual characteristics of the care. The influence is such that to analyze the sector as an isolated factor determining the quality of health care is problematic, particularly if the methodology is not fully robust.

The most positive message from this study is that the CABG mortality in patients from the public health service in Catalonia has halved both in public sector and private sector hospitals, due no doubt in part to measures adopted after publication of the CIRCORCA study. Finally, a conclusion that is missing is that the AATRM scale does not seem to be valid at present for predicting surgical risk associated with CABG.

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