Observational study of nonagenarians undergoing emergency, non-trauma surgery

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Background. Nonagenarian population is growing, and so is the number of them needing emergency surgery. Yet, their treatment is often based on the outcomes of younger patients: although old age is known to be a risk factor for surgery, its level is not clear. This is a prospective, observational study to describe the population. It is aimed at providing quantified scientific evidence of the current procedures and their outcomes.

Methods. All non-traumatic nonagenarians who underwent surgery between July 2006 and September 2010 in our University Hospital were recruited and followed up over a month after discharge. A descriptive statistical analysis was performed.

Results. Of the approximately 12 660 surgical emergencies, 102 were nonagenarians: 69.6% were women, who mostly had an ASA score III (62.7%). Perioperative morbidity and mortality rates of 61.6% [95% confidence interval (CI): 52.33–71.19%] and 35.3% (95% CI: 26.01–44.57%), respectively, were found statistically associated with preoperative neoplasms. The most frequent causes of surgery were acute limb arterial thrombosis (20), incarcerated hernia (17), and bowel occlusion (14). Confusion, renal failure, and abdominal problems accounted for the most frequent causes of morbidity. Among them, abdominal complications, cardiogenic pulmonary oedema, aspiration, stroke, and renal failure were associated with mortality.

Conclusions. The study gave scientific support and actual figures to many intuitive beliefs: morbidity and mortality are high and are associated with many preoperative comorbidities. All this, combined with an already reduced life expectancy, and a presumably low physiological reserve makes these patients particularly vulnerable to emergency surgery.

Keywords: aged, 80 and over; emergencies; surgical procedures, operative

Accepted for publication: 10 October 2010

Nonagenarians are still a small but rapidly emerging population. Although their surgical rates have notoriously increased during the last few decades,1 much of their medical and surgical treatment depends on the experience and results of treating younger patients.2 Furthermore, emergency surgery is carried out more frequently on the elderly than on younger generations, and often in cases where elective surgery might appear unreasonable.3 Nevertheless, most published work dealing with emergencies among 90-yr-olds is based on hip fracture cohorts,4–5 whereas information about all other kinds of emergency procedure is scarce.

Not surprisingly, these patient characteristic changes are raising some controversial issues: it is clear that the benefits of surgical treatment should always be balanced against nonagenarians’ morbidity and mortality rates, as well as their generally shorter life expectancy. However, apart from the general idea that old age is a risk factor for emergency surgery, little is known from literature. In addition, strong economic and ethical concerns have been pointed out.3

As a result, we performed a prospective, observational study in order to understand the current situation. Our aim was to describe the main characteristics of this population in terms of basal status, types of surgery, and perioperative outcomes. With this information, the decision as to whether surgery is the best available treatment can be based on actual figures and not on mere intuitive speculation. We concentrated on non-traumatic patients because the need for surgical repair has been well established in hip fractures.4 5

Methods

The study was conducted between July 2006 and September 2010 in Vall d’Hebron University Hospital; one of the largest hospitals in Barcelona, Spain, which provides medical and surgical care for residents of the city and its surroundings. One of its three major departments, the General Care Hospital, has 643 beds. In its two emergency operating theatres (OTs), an average of 3100 patients annually undergo surgery.
From them, we recruited all patients aged 90 yr and above who underwent an emergency surgical procedure during the study period. Only information from the initial operation on each individual was included in the analysis. Colonoscopies, bronchoscopies, and other diagnostic procedures unattended by anaesthetists were excluded.

The senior anaesthetist on call interviewed each patient before entering the OT. Baseline characteristics and preoperative medical conditions were registered, and patients were classified according to the American Society of Anesthesia (ASA) score. In addition, we asked for a contact telephone number in order to enable the follow-up after discharge.

Information about the major diagnosis, surgical procedures, and anaesthetic technique was collected. We considered every new disease or complication derived from the surgical procedure as postoperative morbidity, if it occurred during admission or within 30 days after discharge. To define them, we used the criteria established in the POSSUM score.\(^9\) Deaths that occurred during that same period were recorded as perioperative mortality. Every complication was diagnosed by the investigators involved in the study, except for postoperative confusional states (confusion, disorientation, and delirium). Because of their sudden and unpredictably transient nature, the surgeon in charge diagnosed and registered these states when the patients were in the ward, and the anaesthetist on call, when the patients were in the post-anaesthesia care unit.

A descriptive statistical analysis was performed with SPSS 11.0. Absolute frequencies, percentages, and 95% confidence intervals (95% CI) were calculated for categorical variables; means, SDs, and 95% CI, for continuous ones. The statistical relation between qualitative variables was assessed with a chi-square (\(\chi^2\)) test, or Fisher’s exact test when \(\chi^2\) was used to assess the independence of two variables, and with a two-tailed value of \(P\) was considered evidence not attributable to chance.

### Results

A total of 119 nonagenarians were operated on in the emergency OT of the General Care Hospital during the study period (about 0.90% of the total emergency surgery volume). Of them, nine were placed an emergency pleural drain, and eight patients were referred to another hospital during admission or within 30 days after discharge. To define them, we used the criteria established in the POSSUM score.\(^9\) Deaths that occurred during that same period were recorded as perioperative mortality. Every complication was diagnosed by the investigators involved in the study, except for postoperative confusional states (confusion, disorientation, and delirium). Because of their sudden and unpredictably transient nature, the surgeon in charge diagnosed and registered these states when the patients were in the ward, and the anaesthetist on call, when the patients were in the post-anaesthesia care unit.

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### Table 1: General findings

<table>
<thead>
<tr>
<th>Morbidity</th>
<th>Number of patients (%)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need to re-operate</td>
<td>7 (6.9)</td>
<td>1.95–11.76%</td>
</tr>
<tr>
<td>In-hospital mortality</td>
<td>30 (29.4)</td>
<td>20.56–38.25%</td>
</tr>
<tr>
<td>Mortality after discharge</td>
<td>5 (4.9)</td>
<td>0.71–9.09%</td>
</tr>
<tr>
<td>Need to be readmitted to</td>
<td>14 (13.7)</td>
<td>7.04–20.40%</td>
</tr>
<tr>
<td>hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total perioperative mortality</td>
<td>36 (35.3)</td>
<td>26.01–44.57%</td>
</tr>
</tbody>
</table>

### Table 2: Comorbidities

<table>
<thead>
<tr>
<th>Comorbidities</th>
<th>Number of patients (%)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension (HT)</td>
<td>59 (57.8)</td>
<td>48.25–67.42%</td>
</tr>
<tr>
<td>Atrial fibrillation (AF)</td>
<td>37 (36.3)</td>
<td>26.94–45.60%</td>
</tr>
<tr>
<td>Congestive heart failure (CHF)</td>
<td>29 (28.4)</td>
<td>19.68–37.18%</td>
</tr>
<tr>
<td>Cancer</td>
<td>23 (22.5)</td>
<td>14.43–30.66%</td>
</tr>
<tr>
<td>Dementia</td>
<td>24 (23.5)</td>
<td>15.30–31.76%</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease (COPD)</td>
<td>21 (20.6)</td>
<td>12.74–28.43%</td>
</tr>
<tr>
<td>Diabetes (DM)</td>
<td>21 (20.6)</td>
<td>12.74–28.43%</td>
</tr>
<tr>
<td>Stroke</td>
<td>19 (18.6)</td>
<td>11.07–26.18%</td>
</tr>
<tr>
<td>Myocardial ischaemia (MI)</td>
<td>16 (15.7)</td>
<td>8.63–22.74%</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>15 (14.7)</td>
<td>7.83–21.58%</td>
</tr>
<tr>
<td>Prostatic hyperplasia</td>
<td>13 (12.7)</td>
<td>6.27–19.21%</td>
</tr>
<tr>
<td>Chronic renal failure</td>
<td>11 (10.8)</td>
<td>7.76–16.8%</td>
</tr>
</tbody>
</table>

Data regarding the distribution of patients according to their diagnosis and procedures are shown in Table 3. Interestingly, the most common diagnoses were incarcerated hernia (17 patients), acute arterial thrombosis of a limb (20 patients), and intestinal occlusion (14 patients). Altogether, they accounted for 50% of all the diagnosis. Only mortality rates of general and vascular surgery should be considered in the analysis, as the 95% CI of all other specialities resulted too wide to draw any conclusion.

Regarding anaesthesia, few cases required unusual techniques for the procedure: one of the colectomies and one laparoscopic procedure for the treatment of acute arterial thrombosis of a limb embolectomy to treat acute arterial thrombosis.

Interviews showed that they had a median of four comorbidities per patient (range 1–12). The main findings concerning morbidity and mortality are shown in Table 1.

As far as preoperative conditions are concerned, Table 2 shows the main comorbidities and their frequencies. A statistically significant increase in postoperative morbidity (\(P=0.02\)) and mortality rates (\(P=0.001\)) was only demonstrated in patients who had a neoplasm. In addition, we found a higher morbidity rate (\(P=0.03\)) in patients who had a history of stroke, and a tendency towards higher morbidity (\(P=0.053\)) in patients with myocardial ischaemia. As expected, higher ASA scores were linearly associated with higher morbidity (\(P=0.005\)) and mortality (\(P=0.006\)) rates.
of the bowel resections were carried out under epidural instead of general anaesthesia; and one of the hernioplasties with local anaesthesia and sedation. Similarly, for the periodontal abscess drainage, the anaesthetist decided to sedate the patient instead of using general anaesthesia.

Table 4 shows the main postoperative complications, the most frequent ones being confusion/delirium, renal failure, and abdominal complications (this category includes anastomotic leak, wound dehiscence, and persistent ileus).

The complications that were statistically associated with mortality in the bivariate analysis were cardiogenic pulmonary oedema (P = 0.003), aspiration (P = 0.001), renal failure (P = 0.016), stroke (P = 0.03), and abdominal complications (P = 0.001). It should be underlined that only one of the patients who died as a result of cardiac complications had previously been diagnosed with heart disease; none of the patients who suffered aspiration were either demented or had a documented deglutition disturbance; furthermore, aspiration (mainly after abdominal surgery) never occurred during induction of anaesthesia. Finally, stroke was not associated with preoperative atrial fibrillation or neoplasms, and acute renal failure was associated—in only one patient—with previously known chronic renal failure. There were two other complications associated with death, respiratory insufficiency (P = 0.042) and sepsis (P = 0.003). On the other hand, confusional states were registered mainly in patients who had a previous diagnosis of dementia (16 cases).

**Discussion**

This is the first study to shed light on the condition in which nonagenarians undergoing emergency surgical procedures are admitted to hospital, and describes their most frequent diagnosis and procedures. Our main achievement was to measure and quantify their perioperative outcomes, that is, although old age had been recognized as an important risk factor, an actual figure is given here to morbidity and mortality rates. As a result, it could be a valuable tool when making decisions as to whether to operate on these patients or not. (Other factors, such as ethical concerns, must also be taken into account.)

Regarding the sample size, the low percentage of surgical nonagenarians in this series (0.90%) compared with others (about 5% in Mitsunaga’s cohort), is mainly due to the fact that all traumatic patients were excluded from this study and not from the others (hip fractures usually account for almost half of all surgical volume in this population).
As far as the baseline characteristics are concerned, the patients did not substantially differ from an equivalent but healthy population: Formiga and colleagues\(^1\) presented in the Nona-Santfeliu study a sample of nonagenarians whose characteristics were similar to ours in both their sex distribution and comorbidity rates. Some comorbidities in this population, however, were 10% more frequent than those in Formiga’s group (DM, MI, CHF, and COPD). Only stroke and dementia were virtually identical in both series. Furthermore, like the Nona-Santfeliu study and unlike the Danish 1905 cohort survey,\(^12\) the number of comorbidities in these patients was correlated with mortality.

Most findings are difficult to compare or contextualize, as other published series are retrospective or include elective procedures: both Ackermann and colleagues\(^2\) and Hosking and colleagues\(^13\) report similar perioperative mortality rates for their emergency patients (19.8% and 17.4%, respectively), which are significantly lower than our 35.3%. Note, however, that they have included hip fractures in their results, and these have much lower mortality rates.\(^2\) 5–7 On the contrary, Adkins and Scout\(^14\)—who did not include trauma cases—found a mortality rate for emergency procedures of about 43%. Again, their results are difficult to correlate with those presented here, as their study was published in 1984, when surgical and anaesthetic techniques were presumably less developed. Similarly, most diagnosis and procedures reported by Ackermann and colleagues\(^2\) coincided with ours, but there was a significant difference in their frequencies. Like certain authors’ reports,\(^13\) intra-abdominal surgery had high mortality rates.

With respect to postoperative morbidity, the fact that most of the patients who suffered a fatal complication had no previously known history of that disease could be an indication of the low functional reserve among nonagenarians:\(^1\) 8 15 although their basal function might seem relatively normal, they lack the capacity to compensate for physiological or surgical stress. As a result, they can develop severe unexpected complications in the perioperative period.

A most unexpected finding was the lack of association between cognitive impairment and mortality. Other studies\(^13\) 16 pointed out dementia as a major independent predictor of mortality, whereas here it was only associated with postoperative confusional states. A possible explanation for this could be the difference in the study designs: this association was present in large cohorts of healthy patients followed up for years, and this conclusion only became clear after the second year.\(^11\) In this study, where patients are only assessed during their immediate perioperative period, the influence of cognitive impairment on mortality is not evident. Nevertheless, from an ethical point of view, guidelines that determine the degree of cognitive impairment whereby aggressive procedures should be precluded would be very useful.

The main limitation to this study is the low number of patients; a larger sample would enable further stratification, and a multivariate analysis of risk factors. However, although the population is increasing, nonagenarians are still very few. Moreover, those who undergo emergency surgery are a further minority among this minority. Other limitations include: the rate of postoperative confusional states might be overestimated—especially for demented patients—because in most cases, the surgeon diagnosed it clinically. Also, due to the emergency setting, certain risk factors for postoperative mortality in the elderly surgical patients could not be checked.\(^17\) Moreover, the population includes only those patients who actually underwent a surgical procedure, but not those where surgery was precluded because of their condition. As a result, we should take into account this selection bias when interpreting these findings.

To sum up, we should bear in mind, when treating these patients, that their morbidity and mortality rates are high even for simple procedures, and that although cognitive impairment is not associated with immediate perioperative mortality, it does reduce the already short life expectancy. Considering the rapid increase of their number, and the amount of healthcare resources they consume,\(^17\) understanding the current situation of this population should help in making conscientious decisions, and also in planning future strategies within the Health Care System.

**Conflict of interest**

None declared.

**Funding**

None of the investigators received any funding for this study.

**References**