

All-cause mortality rates in nonagenarians treated for hip fracture

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Abstract

Aims

To identify in-hospital, 30-day, and one-year mortality rates in patients aged 90 and above who underwent hip fracture surgery at an Irish tertiary referral hospital.

Methods

The authors retrospectively examined two years of theatre lists from 2021 to 2023. Inclusion criteria were an age of 90 and above at the time of fracture and surgical treatment of a proximal femur fracture. Exclusion criteria were periprosthetic fractures and patients who had conservative management. Mortality rates were extracted from hospital records and a national online death notices website.

Results

We identified 69 patients aged greater than 90 years old who received surgical management of a hip fracture between November 2021 and November 2023. Among these 69 patients, in-hospital mortality was 6 (8.7%), 30-day mortality was also 6 (8.7%), and one-year mortality was 23 (33%).

Conclusion

The one-year mortality rate among a sample of nonagenarians managed surgically for hip fracture at a single Irish hospital is higher than the estimated all-age one-year mortality rate, demonstrating significant long-term mortality in the eldest patients. No “90 paradox” was observed in mortality rates.

Introduction

Hip fractures are one of the most commonly encountered issues in the separate fields of geriatric medicine and orthopaedic surgery. They present several issues in this older age cohort in relation to both morbidity and mortality, but also a severe burden in healthcare costs worldwide. In Ireland, the average life expectancy has continued to rise in recent

times, therefore the incidence of hip fracture in this older generation has also continued to grow. It has been reported previously in Ireland that for patients aged 60 years and above, the mortality rates at both 30 days and one year following surgical treatment of hip fractures have been calculated as 4.7% and 24.2% respectively¹. This confirms the serious issues associated with these injuries especially in the older age demographic.

The impact of hip fractures has also been reported as a real cause for concern in the rest of the world. Downey et al² undertook a systematic review reported European one-year mortality rates of greater than 23.% and 22.0% worldwide, suggesting a consistent burden across healthcare systems. Despite efforts to make improvements in surgery and perioperative care with the implementation of thorough rehabilitation pathways, mortality rates following hip fractures are still a real point of issue. This will be experienced most profoundly for older population members, who are at a higher likelihood of becoming frailer and more immobile, ultimately losing their independence and being deemed unfit to resume their life as they previously lived it.

As populations have become older, there has been increasing interest placed into the health markers and outcomes of the category aged 90 and above also referred to as nonagenarians. In Ireland, the current average life expectancy for a male is 80.7 years and 84.0 years for females³. Nonagenarians, by definition, have exceeded these averages by a considerable margin. This in itself can raise areas of clinical interest. Do individuals that are 90 years and above possess a more robust physiological reserve and could this resilience result in better outcomes following major injuries such as hip fractures?

The notion of a so-called “90 paradox” has been suggested, where patients who are older than 90 years of age may have better outcomes following hip fracture surgery in comparison with younger age groups. This perception is predicated on the belief that individuals who live into their 90’s may have a more robust physiological reserve. However, the available evidence that is reported from international studies is in direct contrast to this assumption. Ogawa et al. performed a large retrospective cohort analysis on 565,950 individuals in Japan⁴ and found that nonagenarians had worse when compared to patients in their 80’s or “octogenarians”. Nonagenarians have a greater in-hospital mortality rate of 1.9% whereas their younger counterparts were at 1.2%.

These findings are supported from other international studies such as Bolton et al⁵ who reported a one-year mortality rate of greater than 38.% among nonagenarians in the United States, while our Dutch colleagues Vochteloo et al⁷ reported even higher rates of 42.6% in the Netherlands. In Taiwan, Lin and Liang⁸ found lower one-year mortality rate of 29.5% in nonagenarian patients, but similarly far higher than the national average for all hip fracture patients. These figures highlight the risks that older age groups of patients face undergoing hip fracture surgery as mortality rates appear to rise exponentially as patients age.

Nevertheless, certain studies make the argument that getting older is not the primary determinant for higher mortality outcomes. Ng et al⁹ demonstrated that when patients in their late 80's were matched with younger cohorts for comorbidities status, severity of injury, ASA grade, and preinjury independence levels, significant differences in one-year mortality rates were not appreciated. This was echoed by Graver et al¹⁰ who reported no statistically significant difference in mortality at 30 days in patients aged between 75–89 and those aged 90 and above, when both groups were comparable in terms of clinical characteristics as mentioned above.

In relation to these findings, the outcomes of nonagenarians following hip fracture surgery remains a topic of clinical debate which requires further research to produce more clarity. The management of this older age demographic represents a challenging issue for clinicians. Surgery offers a solution to problem at presentation and provides the only chance for a return to previous mobility and functional recovery. On the other hand, making the decision to operate poses a significant risk of perioperative complications, mortality, and a prolonged in-hospital admission. Understanding the risk profile for each individual regardless of age is integral for making the most informed clinical decision.

In Ireland, there have been efforts to improve hip fracture services in recent years, with the introduction of the Irish Hip Fracture Database (IHFD) which has looked to implement thorough protocols and pathways to be followed for each individual hip fracture admission. However, specific data reported on nonagenarians remains very limited. The vast majority of studies available report outcomes across more generalized age categories, which may potentially misrepresent valuable clinically relevant information in this particularly vulnerable subgroup. Due to the fact that the population of nonagenarians is continuing to grow, more potentially very vulnerable patients will continue to present with various types of hip fractures, it is therefore integral to carry out research specific to this age category.

Our study aims to begin rectifying this knowledge gap by examining the mortality rates of nonagenarians who received surgical treatment for hip fracture at a tertiary hospital in Ireland. We will look to provide clear information on survival rates in nonagenarians by reporting information on in-hospital, 30-day, and one-year mortality outcomes. Our belief is that these findings may assist in guiding clinical practice and provide more insight into perioperative risk.

In summary, hip fractures remain very debilitating in older generations. The concept of a “90 paradox” suggests that nonagenarians be capable of better recovery, however existing evidence contradicts this and suggests this group experiences significantly worse survival outcomes than younger cohorts. It is still unclear about the relative influence that age, comorbidity, and frailty have on these outcomes. This study looks to investigate the

mortality profile of nonagenarians treated for hip fracture in an Irish context, thereby adding to the growing international evidence base on this important clinical issue.

Methods

This was a retrospective study of all nonagenarians who received surgery for a hip fracture at Beaumont Hospital between 01/11/2021 and 01/11/2023. The primary outcome was death following surgical treatment of the hip fracture. Inclusion criteria were an age of 90 and above at the time of fracture, and surgical treatment of the fracture. Fracture types considered for inclusion were: neck of femur fracture (NOF), intertrochanteric, pertrochanteric, and subtrochanteric fracture. Exclusion criteria were conservative management and periprosthetic fracture.

Data was collected by reviewing historic orthopaedic theatre lists in November 2024. Once patients meeting the inclusion criteria had been identified, each patient's survival status was established by referring to the hospital's own IT system, as well as the death notices website RIP.ie. In this manner, for each patient meeting the inclusion criteria, it could be established whether or not they met any of the primary outcomes of death in-hospital, within 30 days, or within one year.

Results

Following a review of the available data from November 2021 to November 2023, 69 patients were identified who met the criteria, ranging in age from 90 to 103 with the mean age at surgery being 93.9. The vast majority of patients were female at 84%. Fracture types were split evenly amongst participants with between NOF and trochanteric fractures. In-hospital and 30-day mortality rates were both 8.7%, while the one-year mortality rate was 33.3%, highlighting the significant long-term risk of death in this cohort. Table 1 depicts an overview of results.

Study sample (n = 69)	
Patient demographics	No. (%)
Age at surgery (mean)	93.9 years
Sex	
Female	58 (84%)
Male	11 (16%)
Fracture type	
Neck of femur	35 (50.72%)
Trochanteric	34 (49.28%)
Mortality	
In-hospital	6 (8.7%)
30-day	6 (8.7%)
One-year	23 (33.3%)

Table 1.1.

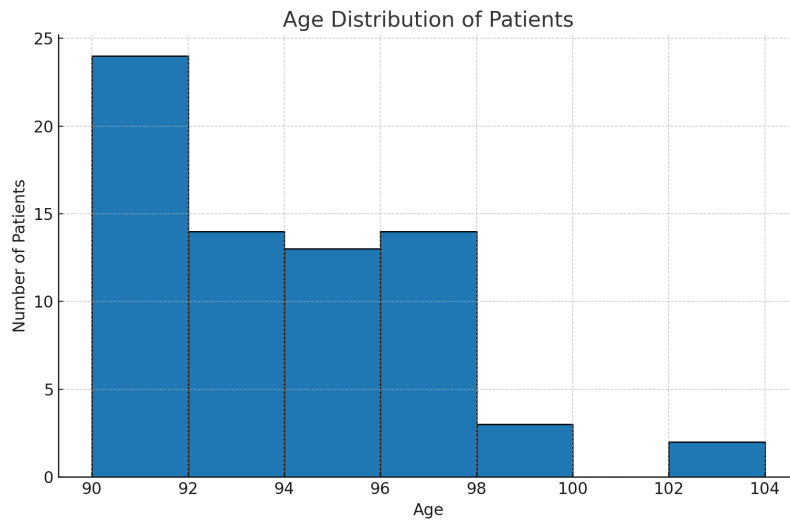


Fig 1.1. Age Distribution.

The ages of patients ranged from 90 to 103 years, with a mean of 93.9 years. The majority of patients clustered between 90 and 96 years, reflecting the typical age distribution of nonagenarian hip fracture patients.

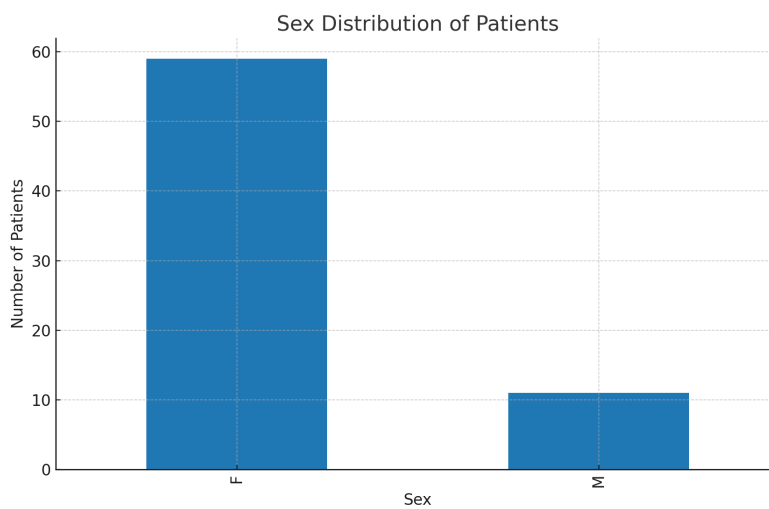


Fig 1.2. Sex Distribution.

Females accounted for a large majority of patients in this cohort at 84% (58 out of 69), while males represented only 16% (11 out of 69). This is reflective of a higher known incidence of hip fractures among older women.

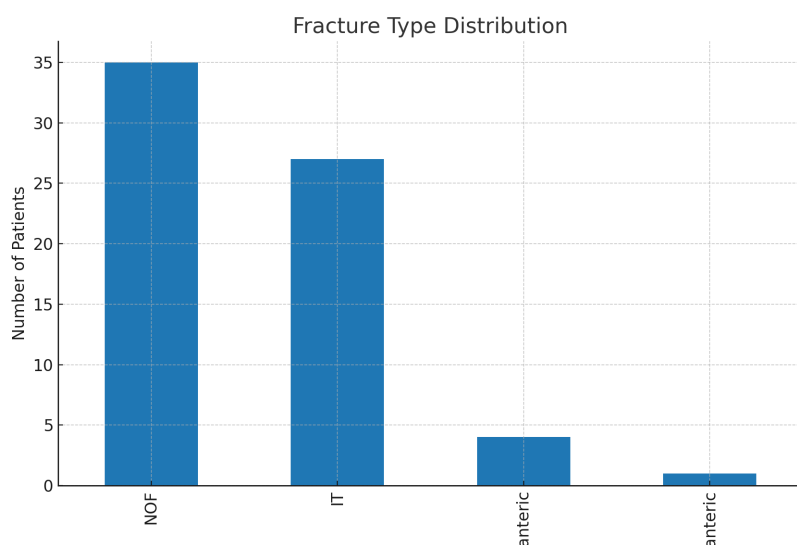


Fig 1.3. Fracture Type Distribution.

Neck of femur fractures accounted for 50.72% of cases (35 patients), while trochanteric fractures made up 49.28% (34 patients). Intertrochanteric fractures yielded the highest number of trochanteric fractures at (27 patients) which accounted for 39.13% of total fractures. No subtrochanteric fractures or other fracture types were recorded in significant numbers.

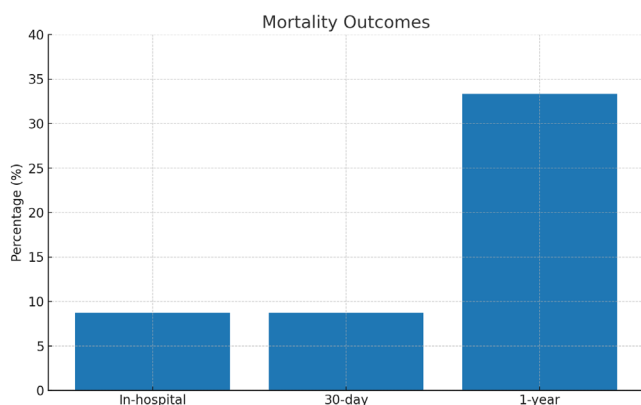


Fig 1.4. Mortality Outcomes.

In-hospital mortality was 8.7% (6 out of 69 patients). The 30-day mortality rate was also 8.7%, reflecting that early postoperative mortality did not increase beyond the in-hospital

period. The one-year mortality rate was 33.3% (23 out of 69 patients), demonstrating the significant long-term risk of death in this frail and elderly population.

Discussion

Our study reports a one-year mortality rate of 33.3% among nonagenarians who were treated with surgical intervention for hip fractures. This was significantly higher than previously reported one-year mortality rates in Ireland. Walsh et al¹ reported a 24% one-year mortality rate but across all ages for patients who had sustained hip fractures. The results of our study emphasize increased vulnerability in this patient group. This can be due to a multitude of reasons such as frailty, poor baseline mobility, and presence of existing comorbidities that influence recovery post-surgery. Although intervention via surgery is often the only option available in attempts to return patients to pre-fracture levels of mobility and function, a definitive outlook for nonagenarians still remains very uncertain and rather ominous. The results of our study would suggest a strong emphasis needs to be placed on perioperative and postoperative strategies in an effort to enhance survival outcomes.

Our study's results are in keeping with European and more global data that report similarly high mortality rates in nonagenarian hip fracture populations. For example, one-year mortality has been observed at 23.4% in Korea⁵, greater than 38% in the USA⁶, as high as 42.6% in the Dutch population⁷, and finally 29.5% in Taiwan⁸. Collectively, these studies demonstrate that nonagenarians consistently sustain higher mortality rates across global healthcare systems following surgery for treatment of hip fractures. The observed rate of 33.3% in our participants is in keeping with this trend, lending validity to the claim that there is a link between advanced age and poor outcomes.

The concept of the so-called "90 paradox", whereby individuals older than 90 might demonstrate superior survival outcomes due to their longevity, was not supported by our findings. Instead, the results contradict this and suggest that longevity does not increase surgical resilience after sustaining a major injury such as a hip fracture. While there are studies that imply comorbidity burden, as opposed to age, is the critical determinant of outcomes^{9,10}, our data nonetheless emphasize that individuals in older age brackets are at particularly high risk. The absence of information on comorbidity and functional status data in this study limits a more nuanced analysis and its external validity. Future studies should be targeted at including these variables to better establish how they affect mortality in a nonagenarian population.

This study is of value to Irish literature because it focuses exclusively on a nonagenarian cohort whose outcomes are not currently well documented in our national database. Strengths include the use of a comprehensive two-year retrospective review at a single

tertiary hospital, ensuring all participants underwent similar perioperative and rehabilitation protocols. There are also limitations that exist, including a small sample size (n=69), lack of detailed clinical variables such as comorbidity and functional status, and the study's restriction to a single tertiary centre, potentially limiting generalisability of results. Larger, multicentre studies in the future would allow us to build on these findings and to better inform clinical practice.

In conclusion, this study reported a one-year mortality rate of 33.3% among nonagenarians who were treated with surgical intervention for hip fractures at an Irish tertiary hospital. This is a significantly higher mortality rate than previously reported in Irish studies. This contradicts the hypothesised “90 paradox”, nonagenarians in this cohort demonstrated inferior outcomes compared to younger cohorts. It can be deduced that nonagenarians are a particularly vulnerable groups that need tailored perioperative care, thorough rehabilitation protocols, dedicated and proactive multidisciplinary support to mitigate the risks associated with such serious injuries. Such alarming mortality rates also prompt the need for preventative strategies, not just an emphasis placed on treatment after the events. This may include falls prevention in the form of supervised sessions to facilitate good levels of mobility and prescription of supplementation to ensure better bone health. Postoperative rehabilitation pathways must be optimized also in relation to access to physiotherapy to improve functional outcomes. Future research incorporating comorbidity profiles, frailty indices, and functional status will be essential to developing these targeted interventions and therapies that may reduce the high mortality burden observed in this population.

Declarations of Conflicts of Interest:

None declared.

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