

Clinical Study

Long-Term Survival of Young Stroke Patients: A Population-Based Study of Two Stroke Registries from Tartu, Estonia

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Received 15 December 2011; Revised 1 February 2012; Accepted 11 February 2012

Academic Editor: Halvor Naess

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The aim of this paper was to evaluate the long-term survival of young stroke patients in Estonia, analyse time trends of survival, and compare the results with other studies. We have used 2 population-based first-ever stroke registry data (1991–1993 and 2001–2003) to analyse the 1-, 5-, and 7-year outcome of young stroke patients by the Kaplan-Meier method of analysis. From the group of 1206 patients, 129 (11%) were aged under 55 years. The overall survival rate at 1, 5, and 7 years was 0.70 (95% CI 0.62–0.78), 0.63 (95% CI 0.55–0.72), and 0.61 (95% CI 0.53–0.70), respectively. The survival was significantly worse for patients with intracerebral haemorrhage ($P < 0.01$) and for those aged from 45 to 54 years compared to the younger age group from 0 to 44 years ($P = 0.03$). For patients with ischemic stroke, aged from 15 to 44 years, the 1-, 5-, and 7-year survival rate was 0.89 (95% CI 0.79–1.00), 0.75 (95% CI 0.61–0.93), and 0.75 (0.61–0.93), respectively. There was no difference in overall survival between the two studied periods. We report a low long-term survival rate among young stroke patients in Estonia. Increasing age and hemorrhagic stroke subtype were associated with lower survival. We have previously shown a worse outcome for 1-year survival compared to other studies and currently this trend continues for 5- and 7-year survival rates. In fact, these are the lowest survival rates for the combined and separate stroke subtypes reported so far.

1. Introduction

A young patient with a stroke is always a challenge, even for a stroke physician. Although the outcome of a stroke in the young is believed to be better, it still has a significant impact on the person's quality of life and moreover can be fatal. Data about long-term survival of young stroke patients are scarce and are usually collected retrospectively or are hospital-based [1–20]. Most of these studies have included ischemic strokes and have reported a rather good prognosis but some of the studies were performed years ago when the diagnostic criteria for stroke differed considerably.

Stroke incidence is known to be higher in developing countries, and also in Eastern Europe, compared to the Western countries. In Estonia, the total first-ever stroke incidence is comparable to that of other European countries, but is higher for the younger age groups [21]. The incidence declined by 2001–2003, but it was still 13 per 100 000 for the subjects aged 0 to 44 and 118 per 100 000 for subjects aged

45 to 54 years in Tartu, Estonia [22]. In addition, the 1-year outcome of stroke in terms of functional deficit and survival has also been worse compared to the data from several other study centres [23].

The aim of this paper was to evaluate long-term survival of young stroke patients in Estonia, analyse changes in survival between 1991 to 2003, and compare the results with other studies.

2. Methods

Data from the two population-based stroke registries [21, 25] from Tartu, Estonia, were used. The first registry included all first-ever in a lifetime strokes from 1991 to 1993 (3 years) and the other registry included patients from 2001 to 2003 (2 years). These registries included both hospitalised and nonhospitalised cases and prospective “hot pursuit” case-finding methods were used to assure the inclusion of all stroke patients in the area. The more detailed description

TABLE 1: Median survival rates by age group, stroke subtype, and gender.

Time	Survival	95% CI	Survival	95% CI	Survival	95% CI	P value
	All		Men		Women		
1 year	0.70	0.62–0.78	0.73	0.63–0.83	0.65	0.53–0.80	0.45
5 years	0.63	0.55–0.72	0.61	0.52–0.73	0.65	0.53–0.80	
7 years	0.61	0.53–0.70	0.59	0.49–0.71	0.65	0.53–0.80	
			0–44 years (<i>n</i> = 41)		45–54 years (<i>n</i> = 88)		
1 year			0.85	0.75–0.97	0.63	0.53–0.74	0.03
5 years			0.73	0.61–0.89	0.58	0.49–0.69	
7 years			0.73	0.61–0.89	0.56	0.46–0.67	
	BI (<i>n</i> = 91)		ICH (<i>n</i> = 26)		UND (<i>n</i> = 12)		
1 year	0.79	0.71–0.88	0.39	0.24–0.63	0.67	0.45–0.99	<0.001
5 years	0.71	0.63–0.81	0.31	0.17–0.55	0.67	0.45–0.99	
7 years	0.69	0.60–0.79	0.31	0.17–0.55	0.67	0.45–0.99	
			BI 0–44 years (<i>n</i> = 30)		BI 45–54 years (<i>n</i> = 61)		
1 year			0.90	0.80–1.00	0.74	0.64–0.86	0.15
5 years			0.77	0.63–0.93	0.69	0.58–0.82	
7 years			0.77	0.63–0.93	0.66	0.55–0.79	

of methods used for data collection, definitions, and other criteria for these registries have been published earlier [21, 22, 25].

In this current study, patients aged <55 years at stroke onset were included in the analysis. The Estonian Population Register was used for obtaining survival data. The cut-off point for survival data was February 2001 for the first and January 2011 for the second registry for the evaluation of the 7-year outcome.

The study was approved by the Ethics Review Committee on Human Research of the University of Tartu.

2.1. Statistical Methods. Survival rate was estimated by the Kaplan-Meier method (1-, 5-, and 7-year survival rate). Survival distributions were compared using the log-rank test. *P* values less than 0.05 were considered significant. The analysis was carried out by the statistical software package R.

3. Results

A total of 1280 patients, (501 men and 779 women) with first-ever stroke, were registered during the 5-year study period, with 829 patients from 1991 to 1993 and 451 patients from 2001 to 2003. Patients with subarachnoid haemorrhage (64 patients) were excluded from this current analysis and additionally 10 patients were lost for the long-term followup. From the group of 1206 patients, 129 (11%) were <55 years of age (38% women and 62% men), and these were included in the survival analysis. The mean age of patients was 46.1 (± 9.6) years (range 1 to 55 years). Of them, 91 (71%) had a brain infarction (BI), 26 (20%) an intracerebral haemorrhage (ICH), and 12 (9%) had an undefined type of stroke (UND). Only 3 patients were <15 years of age (2 of them with BI and one with ICH). Perinatal strokes were not included.

Sixty-four of 129 patients (50%) had hypertension, 4 (3%) atrial fibrillation, 17 (13%) diabetes mellitus, 20 (16%) ischemic heart disease, and 7 (5%) had had a previous transient ischemic attack. In 48 patients (38%), no cardiovascular risk factors were identified at stroke onset. The survival rates by age, gender, and stroke subtypes are shown in Table 1. For comparison with previous studies we also calculated the survival rates for patients with ischemic stroke aged 15 to 44 years. The 1-, 5-, and 7-year survival rates were 0.89 (95% CI 0.79–1.00), 0.75 (95% CI 0.61–0.93), and 0.75 (0.61–0.93), respectively.

As expected, the survival rate was worse for patients with ICH and for the older age group. There was no significant difference in overall survival rates between the two studied periods (*P* = 0.8) nor in young ischemic stroke survival between the two study periods (*P* = 0.6).

4. Discussion

The main finding of our study is the low long-term survival rate among young first-ever stroke patients. At the same time most previous reports agree that although the survival of young stroke patients is lower than in the general population, it is still comparatively high [17, 26]. Our previous study [23] has shown a worse outcome for 1-year survival compared to other studies and currently this trend continues for 5- and 7-year survival rates. In fact, these are the lowest survival rates for combined and separate stroke subtypes reported so far. In our study increasing age (0–44 years versus 45–54 years) and hemorrhagic stroke subtype were associated with lower long-term survival. Earlier studies have also found an association between the male gender and higher mortality in young stroke patients [2, 4]. Although this trend can also be seen in our study, it did not reach statistical significance. The more recent study by Putaala et al. [16] could also not

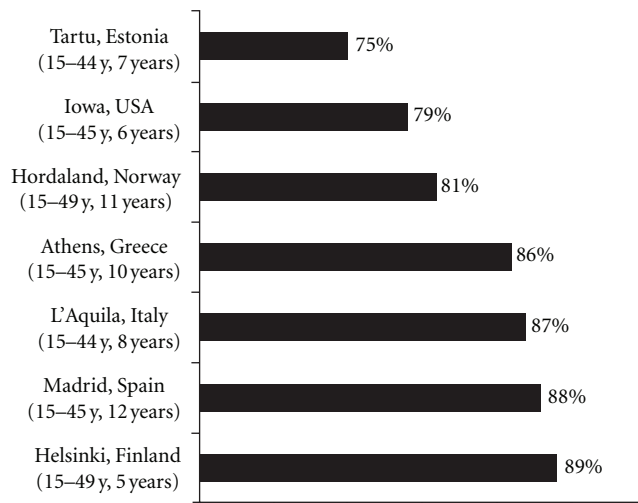


FIGURE 1: Survival of young patients with ischaemic stroke in different studies [1, 2, 4, 16, 18, 24].

identify this association. Quite surprisingly, the survival rate for women remained unchanged after 1 year.

The survival rates for young ischaemic stroke patients from several studies are summarized in Figure 1. The general annual survival rate follows the pattern of earlier studies being clearly lowest in the first year and significantly increases thereafter, but is constantly lower than other studies. The differences in survival rates across the studies could be associated with several aspects. The study type, inclusion criteria, follow-up period, and type of data analysis differ across studies. All, with the exception of three [2, 17, 18], have been hospital based and do not represent a defined population. Although the follow-up periods in these studies are variable, the trend of outcome is still obvious. The results of our study come from two prospective population-based registries. However, a limitation of our study is the small sample size.

The main factor for low survival may be severe stroke, and although there are no comparative data, we speculate that stroke cases are more severe in Estonia. This may be related to a higher prevalence of risk factors leading to a worse outcome. However, in 38% of cases no cardiovascular risk factors were identified despite extensive diagnostic tests. This points to the fact that there may be also other possible causes for higher stroke incidence and lower survival among young subjects in Estonia, for example, genetics, lifestyle, or environmental factors. However, these hypotheses are difficult to prove. And finally, the life expectancy in Estonia was 75.8 years in 2010, 70.6 years for men and 80.8 years for women. Although this rate has constantly grown during the past decade, it is still 3 to 4 years less for women and 5 to 7 years less for men, compared to that of most other European countries [27]. Still, there was no significant difference in stroke survival between the two study periods.

Unfortunately, we were not able to identify the causes of death of young stroke patients because of the strict Estonian data protection legislation. The causes of death

are confidential and coded linking between registries is not allowed. As the cardiovascular mortality and deaths, due to accidents and excess alcohol intake, are high in the young Estonian population (especially in men), a number of our young stroke patients might die due to other causes rather than from stroke.

5. Conclusion

Long-term survival rates of young stroke patients differ significantly across the world. The causes of high stroke incidence and low survival rates in Eastern Europe can be explained in some terms, but the proportion of stroke patients with no identifiable risk factors is high. Future studies and everyday clinical practice should focus on thorough detection of the etiology of stroke, promoting a healthy lifestyle, optimizing primary and secondary prevention strategies thus decreasing the incidence of stroke and achieving a better outcome for young stroke patients.

Acknowledgment

The study was supported by targeted financing from the Estonian Ministry of Education and Research (Grant no. SF0180064s07).

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