

CHANGES RELATED TO INPATIENT MORTALITY FROM ACUTE STROKE IN THE STROKE UNIT OF THE KLAIPEDA UNIVERSITY HOSPITAL IN 2007-2015

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Key words: acute stroke, inpatient mortality, changes

Summary

The aim of the study was to analyse the changes in inpatient mortality from acute stroke in the stroke unit of the Klaipeda University Hospital in 2007-2015. Medical history data of 265 patients who died from acute stroke in the stroke unit were analysed. Inpatient mortality rate was calculated among all patients diagnosed with acute stroke who were treated in the stroke unit during the entire study period. The number of deaths in different age groups (up until 65; 65 and older) and comorbidities in patients who died from acute stroke were analysed, depending on stroke type in different treatment periods (2007-2011 and 2012-2015).

The International Classification of Diseases, Tenth Revision (ICD-10), Codes I60-I64 were used to diagnose different stroke types in 2007-2011, while ICD-10 AM, Codes I60-I64 were used in 2012-2015. The statistical analysis was performed using SPSS 17.0 for Windows. Chi-squared (χ^2) criterion and Fisher's exact test were used for small samples to evaluate dependency and homogeneity of qualitative characteristics. The difference between them was considered as statistically significant at $p < 0.05$. Data are presented as a percentage. Student's t-test was applied for average age comparison. Odds ratio (OR), reflecting the mortality from acute stroke in different periods, was established. The comparison of the two study periods revealed the decrease in patients who died from acute stroke - from 7.0% (2007-2011) to 4.3% (2012-2015), ($p < 0.001$). Mortality from ischemic and hemorrhagic stroke was similar. The analysis showed significant age difference ($p = 0.007$) among patients who died from acute

stroke: in the later study period (2012-2015), the patients were older than those who died in the earlier period; however, no significant difference was observed when analysing them by age groups (up until 65; 65 and older). The odds of dying in 2007-2011 were 1.69 times higher than in 2012-2015 ($p < 0.001$), whereas the odds ratio for ischemic stroke in 2007-2011 was 1.75 times higher than in 2012-2015 ($p < 0.0001$). No significant difference between different study periods was established when analysing the changes in the number of comorbidities in patients who died from acute stroke. The assessment of differences in comorbidities depending on the stroke type revealed that significantly more patients who died from ischemic stroke had been diagnosed with coronary heart disease (CHD) (including angina pectoris (AP) and atrial fibrillation (AF)) than those who died from hemorrhagic stroke. It was concluded that, when comparing the two study periods, the number of patients who died from acute stroke decreased significantly - from 7.0% (2007-2011) to 4.3% (2012-2015) ($p < 0.001$). The odds ratio for dying from acute stroke in 2007-2011 was established to be significantly higher than in 2012-2015 and patients who died from acute stroke in the later study period were significantly older.

Introduction

Inpatient mortality is defined as the number of people who die during the first 30 days after entering the hospital. Not all countries and hospitals provide a possibility to monitor patients discharged from the hospital; therefore, this type of mortality rate is often limited to the determination of mortality within the hospital. Nevertheless, standardised mortality rate is often used for comparative analysis between countries [1]. In addition, the survival rate after stroke

reflects the quality of care, and in particular, the effectiveness of treatment and care. Scientific research found that, in many countries of the world, inpatient mortality varies from 6 to 14% [2]. In the European Union countries, the average inpatient mortality rate for ischemic stroke patients is about 5.4% whereas for hemorrhagic stroke patients is about 20.2%. The latter indicators vary between countries. It was found that standardised average inpatient mortality rate for hemorrhagic stroke patients is four times higher compared to analogous rate for ischemic stroke patients [1]. Different mortality rates are mainly determined by the medical service organisation operating outside and within the hospital [3], as well as by the severity of stroke [4,5]. Research during the recent decades has shown that inpatient mortality is decreasing in most industrialised countries [6]; however, there is little data on changes in hospital mortality from stroke [6, 7].

Study objective: to analyse the changes in mortality from acute stroke in the stroke unit of the Klaipeda University Hospital in 2007-2015.

Subject and Methods

Medical history data of 265 patients who died from acute stroke in the stroke unit were analysed. Inpatient mortality rate was calculated among all patients diagnosed with acute stroke who were treated in the unit during

Table 1. Characteristics of patients who died from acute stroke in 2007-2015

*indicator falls outside the normal distribution - data are presented as average (median) - Mann-Whitney U test was applied.

Indicators	2007-2015	2007-2011	2012-2015	p
	N=265	N=156	N=109	
Gender:				
Men	107(40.4%)	62(39.7%)	45(41.3%)	0.801
Women	158(59.6%)	94(60.3%)	64(58.7%)	
Age, average \pm SD	79.05 \pm 8.09	77.91 \pm 7.65	80.67 \pm 8.46	0.007
Up to 65 years	14(5.3%)	9(5.8%)	5(4.6%)	0.672
65 years and older	251(94.7%)	147(94.2%)	104(95.4%)	
Stroke type:				
Ischemic stroke	237(89.4%)	143(91.7%)	94(86.2%)	0.157
Hemorrhagic stroke	265(10.6%)	13(8.3%)	15(13.8%)	
Comorbidities:				
Diabetes mellitus	28(10.6%)	18(11.5%)	10(9.2%)	0.538
Coronary heart disease	180(56.2%)	104(66.7%)	76(69.7%)	0.600
Arterial hypertension	95(35.8%)	54(34.6%)	41(37.6%)	0.616
Atrial fibrillation	112(42.3%)	66(42.3%)	46(42.2%)	0.986
Angina pectoris	149(56.2%)	83(53.2%)	66(60.6%)	0.236
Pneumonia	172(64.9%)	97(62.2%)	75(68.8%)	0.266
Bed-days, average (median)	9.61(7)	9.06(7)	10.40(8)	0.060

the entire study period. The International Classification of Diseases, Tenth Revision (ICD-10), Codes I60-I64 were used to diagnose different stroke types in 2007-2011, while ICD-10 AM, Codes I60-I64 were used in 2012-2015. Data of patients treated for acute ischemic stroke (codes I63-I64), hemorrhagic stroke (codes I61-I62) and subarachnoid hemorrhage (SAH) (code I60) were analysed. Due to the small number of patients with SAH, they were included in the research group diagnosed with hemorrhagic stroke. Changes in age, comorbidities and other attributes of patients who had been diagnosed with different acute stroke types and died in the study period were assessed.

To this purpose, the whole study period was divided into two periods: the first (2007-2011) and the second one

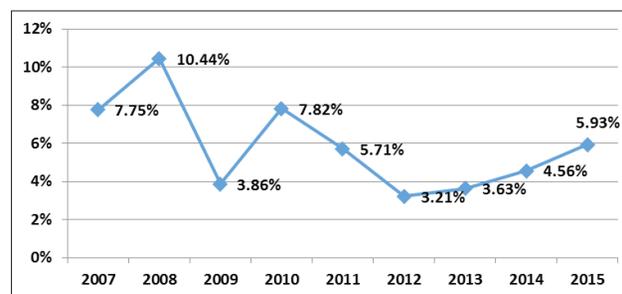


Figure 1. Overall mortality from acute stroke in the stroke unit of the Klaipeda University Hospital in 2007-2015

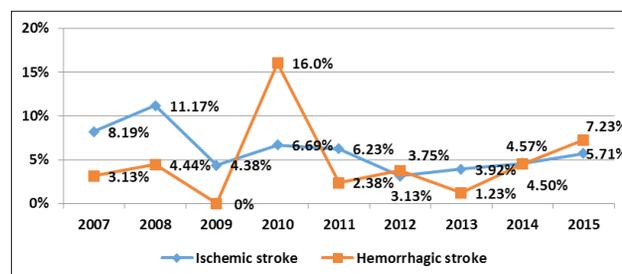


Figure 2. Mortality from ischemic and hemorrhagic stroke in the stroke unit in 2007-2015

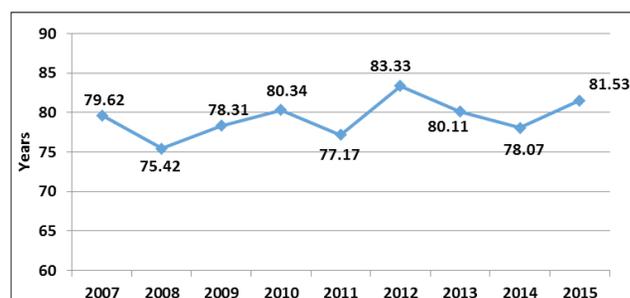


Figure 3. Age of patients who died from acute stroke in 2007-2015

Table 2. Outcomes of acute stroke patients in the different study periods and odds ratio

Indicators	2007-2011	2012-2015	p	OR	95%CI
	N=2240	N=2564			
Stroke type:					
Ischemic stroke	1979(88.35%)	2209(86.15%)	0.023	1.22	1.03-1.45
Hemorrhagic stroke	261(11.65%)	355(13.85%)			
Outcome:					
Died	156(6.96)	109(4.25)	<0.001	1.69	1.31-2.17
Survived	2084(93.04)	2455(95.75)			
Ischemic stroke:	n=1979	n=2209			
Died	141(7.12)	93(4.21)	<0.001	1.75	1.33-2.28
Survived	1838(92.88)	2116(95.79)			
Hemorrhagic stroke:	n=261	n=355			
Died	14(5.36)	15(4.23)	0.511	1.28	0.61-2.71
Survived	247(94.64)	340(95.77)			

Table 3. Age, gender and comorbidity related changes in patients who died from acute stroke depending on stroke type

Indicators	Stroke		χ^2	p
	Ischemic	Hemorrhagic		
	n=237	n=28		
Age	79.21±7.85	77.68±10.02	t=0.779	0.442
Gender			2.264	0.132
Men	92(38.8%)	15(53.6%)		
Women	145(61.2%)	13(46.4%)		
Comorbidities:				
Diabetes mellitus	28(11.8%)	-	3.699	0.054
Coronary heart disease	170(71.7%)	10(35.7%)	14.909	<0.001
Arterial hypertension	81(34.2%)	14(50.0%)	2.726	0.099
Atrial fibrillation	108(45.6%)	4(14.3%)	10.043	0.002
Angina pectoris	141(59.5%)	8(28.6%)	9.729	0.002
Pneumonia	153(64.6%)	19(67.9%)	0.120	0.729
Study periods			2.001	0.157
2007-2011	143(60.3%)	13(46.4%)		
2012-2015	94(39.7%)	15(53.6%)		

(2012-2015). The research contingent was divided into two age-based groups: the first one - up to 65 years and the second one - 65 years and older. The data obtained were compared between the two periods.

Statistical Analysis. The statistical analysis was performed using SPSS 17.0 for Windows. Chi-squared (χ^2) criterion and Fisher's exact test were used for small samples to evaluate dependency and homogeneity of qualitative characteristics. The difference between them was considered as statistically significant at $p < 0.05$. Data are presented in the number of cases (percentage). Student's t-test was applied for average age comparison and Mann-Whitney U test was used to compare bed-days. Odds ratio (OR), reflecting the mortality from acute stroke in different periods, was established.

The analysis of the research contingent (Table 1), depending on the study periods (2007-2011 and 2012-2015), revealed some differences. No significant changes were observed when comparing the

stroke types in the two study periods; however, in 2012-2015, the age of the patients under investigation increased significantly – from 77.9 ± 7.6 (2007-2011) to 80.6 ± 8.4 (2012-2015). The number of men increased slightly - from 39.7% (2007-2011) to 41.3% (2012-2015) - and the number of women decreased from 60.3% (2007-2011) to 58.7% (2012-2015). During the two study periods, the number of cases of diabetes mellitus (DM) decreased slightly; however, more cases of arterial hypertension (AH), angina pectoris (AP) and pneumonia (2012-2015) were observed.

Results and Discussion

In the period 2007-2015, mortality from acute stroke in the stroke unit of the Klaipeda University Hospital decreased from 7.75% (2007) to 5.93% (2015) ($p=0.272$) (Figure 1). When investigating in-hospital mortality of patients hospitalised for acute ischemic and hemorrhagic stroke, Sadamasa. et al. found that 7.2% of them died in hospital [7]. Similar inpatient mortality rate (8.4%) as in our study was observed by American (California) researchers [8]; however, their analysis did not target a specialised stroke unit. During the intermediate periods of our study, an increase in mortality up to 10.44% (2008) and a decrease up to 3.21% (2012) were recorded.

In 2007-2015, mortality from ischemic stroke in the stroke unit of the Klaipeda University Hospital declined from 8.19% (2007) to 5.71% (2015). Mortality rate from hemorrhagic stroke in the stroke unit of the Klaipeda University Hospital changed every year in the period 2007-2015 resulting in an overall increase from 3.13% (2007) to 7.23% (2015) (Figure 2). Data presented in Figure 2 show that, in 2009, none of the hemorrhagic stroke patients died; however, in 2010, mortality from this type of stroke increased up to 16%. In other years of the study period, mortality rates between the different stroke types were similar. In contrast to our findings, significantly higher inpatient mortality from hemorrhagic stroke (15.1%), as compared to ischemic stroke (3.5%), was found by the above mentioned Japanese authors [7].

Table 2 shows that, in the later study period, the number of deaths was significantly lower (4.25%), as compared to the earlier one (6.96%), $p < 0.001$.

The analysis of the odds ratio of dying in the

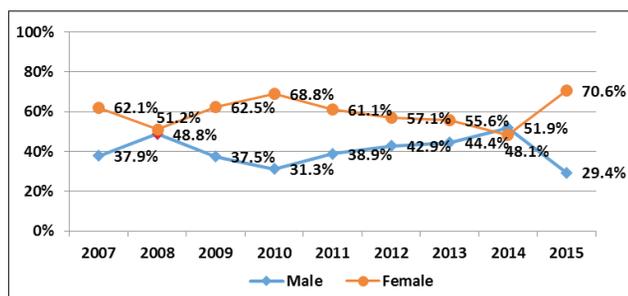


Figure 4. Gender-based changes in patients who died from acute stroke in 2007-2015

different study periods (2007-2011 and 2012-2015) revealed that, in 2007-2011, the odds of dying were 1.69 times higher than in 2012-2015 ($p < 0.001$), whereas the odds ratio of dying from ischemic stroke in 2007-2011 was 1.75 times higher than in 2012-2015 ($p < 0.001$) (Table 2). A variety of reasons might have influenced these results. Research shows that, in a stroke unit, where the average length of treatment is longer than 7 days, inpatient mortality is mostly influenced by stroke severity (about 44.1%), pneumonia (12.2%) or other complications (about 12.6%) [9]. In case of our study, the main reason for better outcome in the second study period could be that possibly more patients who suffered from severe stroke were admitted to hospital and treated in the intensive care unit, despite the significant aging of patients under investigation (Table 1). Besides, it is possible that, in the second period, the quality of treatment has also improved and the number of dangerous early complications of stroke has decreased (e.g. pulmonary embolism (PE), uroinfection, etc.). The analysis showed that the difference in the odds of dying from hemorrhagic stroke in the two study periods was statistically insignificant.

In the period 2007-2015, the age of the patients under investigation increased from 79.6 ± 6.0 years (2007) to 81.5 ± 8.6 years (2015) (Figure 3). It is possible that the changes in aging of patients under investigation are mostly related to the aging of general human population.

In 2007-2015, female mortality increased from 62.1% (2007) to 70.6% (2015.) whereas male mortality decreased from 37.6% (2007) to 29.4% (2015) (Figure 4).

The analysis of changes in the number of comorbidities in patients who died from acute stroke did not reveal any significant differences in the two study periods, even though the number of PE cases in recent years shows a tendency to decrease (Figure 5, Table 1).

Research shows that a combination of several chronic diseases causes higher mortality [10]. The assessment of age, gender and comorbidity related changes depending on

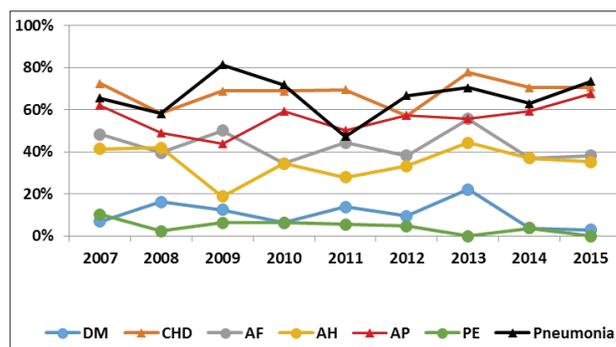


Figure 5. Changes in comorbidities for patients who died from acute stroke in 2007-2015

stroke type revealed that significantly more ischemic stroke patients ($p < 0.001$) had been diagnosed with coronary heart disease (CHD) (including AP and atrial fibrillation (AF) than those who suffered from hemorrhagic stroke (Table 3). These data do not contradict the generally accepted view that CDH (AP and AF) may influence the development of ischemic stroke and subsequent mortality. With regard to hemorrhagic stroke, more frequent cases of AH and pneumonia were observed than in the ischemic stroke group; however, these were not statistically reliable data.

Conclusions

1. In the two study periods, mortality from acute stroke decreased significantly – from 7.0% (2007-2011) to 4.3% (2012-2015).

2. The odds ratio of dying from acute stroke in 2007-2011 was significantly higher (1.69 times) than in 2012-2015. The risk of dying was more pronounced in patients with ischemic stroke: in 2007-2011 it was 1.75 times higher in comparison with the later study period.

3. Patients who died from acute stroke in the later study period were significantly older.

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**STACIONARINIO MIRŠTAMUMO NUO ŪMINIO
 GALVOS SMEGENŲ INSULTO POKYČIAI
 KLAIPĖDOS UNIVERSITETINĖS LIGONINĖS
 INSULTŲ SKYRIUJE 2007-2015 METAIS**

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Raktažodžiai: ūminis galvos smegenų insultas, stacionarinis mirštamumas, pokyčiai.

Santrauka

Darbo tikslas buvo išanalizuoti mirštamumo pokyčius nuo ūminio galvos smegenų insulto (GSI) Klaipėdos universitetinės ligoninės (KUL) insultų skyriuje 2007-2015 metais. Buvo analizuoti 265 nuo ūminio GSI insulto skyriuje mirusiųjų pacientų ligos istorijų duomenys. Pacientų stacionarinis mirštamumas skaičiuotas nuo visų per tiriamąjį laikotarpį skyriuje gydytų pacientų, kuriems

buvo nušalintas ūminis GSI. Analizuotas mirčių kiekis skirtingose amžiaus grupėse (iki 65 m ir 65 m. ir vyresni) bei mirusiųjų nuo GSI lydinčios ligos, priklausomai nuo insulto tipo skirtinguose (2007-2011 m. ir 2012-2015 m.) gydymo laikotarpiuose.

Diagnozuojant atskirus insulto tipus 2007-2011 m. naudota 10 peržiūros Tarptautinė Ligų Klasifikacija (TLK-10) (kodai I60-I64), o 2012-2015 m. (TLK-10 AM) (kodai I60-I64). Duomenys buvo išanalizuoti statistiškai, taikant „SPSS 17.0 for Windows“ programą. Kokybinių požymių priklausomumo ir homogeniškumo vertinimui naudotas chi-kvadrato (χ^2) kriterijus su Fišerio testo patikslinimu, esant mažoms imtims. Skirtumas tarp jų buvo laikomas statistiškai reikšmingu, kai $p < 0,05$. Duomenys pateikiami procentais. Amžiaus vidurkių palyginimui taikytas Stjudent'o t kriterijus. Nušalintų šansų santykis (OR), atspindintis mirštamumą nuo ūminio GSI skirtingais laikotarpiais. Mirusiųjų nuo ūminių insultų, lyginant analizuojamus laikotarpius, sumažėjo nuo 7,0 proc. (2007-2011 m.) iki 4,3 proc. (2012-2015 m.), ($p < 0,001$). Mirštamumas nuo išeminio (IGSI) ir hemoraginio GSI (HGSI) buvo panašus. Analizė parodė mirusiųjų nuo ūminio GSI reikšmingą amžiaus ($p = 0,007$) skirtumą: vėlyvesniame laikotarpyje (2012-2015 m.) mirusieji buvo vyresni nei ankstyvesniame laikotarpyje, tačiau pagal amžiaus grupes (iki 65 m. ir 65 m. ir vyresni) tiriamosios grupės reikšmingai nesiskyrė. Šansų santykis numirti 2007-2011 m. buvo 1,69 karto didesnis nei 2012-2015 m. ($p < 0,001$), tarp jų nuo išeminio GSI 2007-2011 m. 1,75 karto didesnis nei 2012-2015 m. ($p < 0,0001$). Tiriant mirusiųjų nuo ūminio GSI lydinčių ligų skaičiaus pokyčius nenušalinta reikšmingo skirtumo tarp skirtingų tiriamųjų laikotarpių. Vertinant lydinčių ligų skirtumus priklausomai nuo galvos smegenų insulto tipo, mirusiųjų nuo IGSI grupėje buvo reikšmingai daugiau pacientų, kuriems buvo diagnozuota IŠL (tarp jų KA ir PV) nei pacientų grupėje, kuriems diagnozuotas HGSI. Padarytos išvados, kad mirusiųjų nuo ūminio GSI skaičius, lyginant analizuojamus laikotarpius, sumažėjo reikšmingai - nuo 7.0 proc. (2007-2011 m.) iki 4,3 proc. (2012-2015 m.), ($p < 0,001$). Nušalinta, kad pacientų šansų santykis numirti nuo ūminio GSI 2007-2011 m. buvo reikšmingai didesnis nei 2012-2015 m., o mirusieji nuo ūminio GSI pacientai vėlyvesniame tyrimo laikotarpyje buvo žymiai vyresni.

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