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In-hospital Mortality Among Neurological Patients over the Period of 5 years — a Retrospective, Single-center Study

Umieralność wewnątrzszpitalna w okresie 5-letnim wśród chorych neurologicznych — retrospektywne, jednośrodkowe badanie

Adam Wiśniewski

Department of Neurology, Faculty of Medicine, Collegium Medicum in Bydgoszcz,
Nicolaus Copernicus University in Toruń, Poland

Abstract

Introduction. Neurological disorders have been considered for many years dangerous and are associated with higher risk of in-hospital death. Brain vascular disorders are widely considered as the most severe and related to the highest mortality rate.

Aim. The aim of the study was to assess the mortality rate in subjects hospitalized in the Neurology ward within 5 years, in particular the etiology, direct cause and predictability of deaths.

Material and Methods. This study is retrospective. The documentation analysis concerned the last 5 years, i.e. from 2015 to 2019. From among the entire database of 8247 patients hospitalized in the Neurology Clinic of the University Hospital No. 1 in Bydgoszcz, 429 deaths were reported and analyzed.

Results. The mortality rate was 5.2% among all subjects, 6.6% among all vascular patients and 1.16% among non-vascular subjects. The highest mortality was reported among hemorrhagic stroke (28.4%) and it was significantly higher compared to ischemic stroke (OR=6.25, 95% CI 4.9–7.8, $p<0.0001$). Patients with stroke had significantly higher mortality compared to other neurological disorders (OR=11.08 95% CI 7.7–15.9, $p<0.0001$). The main direct reason of death (80%) was primary cerebral as a result of baseline disease. 7% of deaths were considered as sudden, unexpected and 10.7% were related to complications developed during hospitalization.

Conclusions. Stroke, especially hemorrhagic subtype, still remains the cause of the highest in-hospital mortality rate in the Neurology Ward. It is worth to notice that special attention should be paid to patients with coexisting infectious diseases, that contribute to higher mortality risk. (JNPN 2020;9(1):20–26)

Key Words: in-hospital mortality, neurological disorders, stroke, prognosis

Streszczenie

Wstęp. Choroby neurologiczne są od wielu lat uważane za niebezpieczne i wiążące się z dużym ryzykiem zgonu wewnątrzszpitalnego. Za największe zagrożenie uważa się obecnie choroby naczyniowe mózgu, które są obarczone największą śmiertelnością.

Cel. Celem badania była ocena wskaźnika umieralności wśród chorych hospitalizowanych na oddziale neurologicznym w przeciągu 5 lat, ze szczególnym uwzględnieniem etiologii, bezpośredniej przyczyny i przewidywalności zgonów.

Materiał i metody. Badanie to ma charakter retrospektywny. Analiza dokumentacji dotyczyła 5 ostatnich lat tj. od 2015 do 2019 r. Spośród całej bazy danych 8247 pacjentów hospitalizowanych w Klinice Neurologii Szpitala Uniwersyteckiego nr 1 w Bydgoszczy, odnotowano 429 zgonów, które zostały poddane analizie.

Wyniki. Wskaźnik umieralności wyniósł 5,2% wśród wszystkich chorych, 6,6% wśród chorych naczyniowych i 1,16% wśród chorych nienaczyniowych. Największą śmiertelność zanotowano u pacjentów z udarem krwotocznym mózgu (28,4%) i była ona istotnie wyższa w porównaniu z udarem niedokrwiennym (OR=6,25, 95% CI 4,9–7,8, $p<0,0001$). Chorzy z udarem mózgu mają istotnie wyższą śmiertelność w porównaniu z innymi jednostkami neurologicznymi (OR=11,08 95% CI 7,7–15,9, $p<0,0001$). Najczęstszą bezpośrednią przyczyną zgonu (80%) była przyczyna pierwotnie

mózgowa w przebiegu choroby podstawowej. 7% zgonów zakwalifikowano jako nagłe, niespodziewane a 10,7% zgonów było konsekwencją powikłań wewnątrzszpitalnych.

Wnioski. Udar mózgu, zwłaszcza krwotoczny, ciągle pozostaje przyczyną zgonu wewnątrzszpitalnego o największym wskaźniku śmiertelności. Należy zwrócić szczególną uwagę na chorych z towarzyszącymi infekcjami, które istotnie przyczyniają się do większej śmiertelności. (PNN 2020;9(1):20–26)

Słowa kluczowe: umieralność wewnątrzszpitalna, choroby neurologiczne, udar mózgu, prognoza

Introduction

Neurological disorders have been considered for many years dangerous and associated with higher risk of in-hospital death. Brain vascular disorders are widely considered as the most severe and related to the highest mortality rate. Stroke is a key social and medical problem of current times, one the most common reasons of morbidity and the second cause of death worldwide [1]. Its estimated that that one in six inhabitants of Earth will experience a stroke during their lifetime and the death because of stroke occurs about every 6 seconds [2].

It is considered that one third of all stroke subjects will die in the period of six months after the stroke onset and half of them within 2 weeks, in particular during hospitalization [3].

Despite an increase in the incidence of neurological disorders, especially vascular origin, it is observed a gradual decrease in mortality rates. It is associated mainly with greater diagnostic and therapeutic options. This is clearly noticeable, in particular in the progress of specific ischemic stroke treatment (intravenous thrombolysis and mechanical thrombectomy) [4]. However, despite therapeutic advances, high mortality from neurological disorders, in relation to other diseases, still remains a key medical issue for neurologists worldwide.

The aim of the study was to assess the in-hospital mortality rate in the subjects hospitalized in the Neurology ward within 5 years, in particular the etiology, direct cause and predictability of deaths as well as the evaluation of risk factors and complications particularly related to increasing mortality.

Material and Methods

In this retrospective study it was enrolled 429 patients who died of all 8247 subjects who were treated in years 2015–2019 in Department of Neurology at University Hospital No 1 in Bydgoszcz. The medical records of the enrolled patients from 1 of January 2015 to 31 of December 2019 have been analyzed by the researcher. All subjects have been divided into two etiological groups: vascular (ischemic and hemorrhagic stroke, subarachnoidal hemorrhage and transient ischemic attacks) and non-vascular (other neurological disorders).

Sample size was calculated based on the prevalence of neurological disorders in the general population of province (Bydgoszcz, Poland) using an available sample size calculator. The recommended (estimated) sample size was 216 subjects with a confidence level of 95%.

The study was approved by the Bioethics Committee of Nicolaus Copernicus University in Torun at Collegium Medicum of Ludwik Rydygier in Bydgoszcz.

The Mann–Whitney U test was performed to compare the continuous variables and chi-square test were used to compare categorical data. Logistic regression model was used to compare the mortality risk in estimated groups. The significance level of $p < 0.05$ was considered statistically significant. All calculations were performed using STATISTICA software, version 13.1 (Dell Inc., Round Rock, TX, USA).

Results

Mortality Rates

In the whole population the mortality rate was 5.2% (429 deaths of 8247 subjects). Among 3969 subjects with ischemic stroke died 238 (mortality rate 6.0%), among 558 subjects with hemorrhagic stroke died 159 (28.4%) and among 30 subjects with subarachnoidal hemorrhage died 8 (26.7%). Subjects with hemorrhagic stroke had higher risk of mortality compared to ischemic stroke subjects (OR=6.25, 95% CI 4.9–7.8, $p < 0.0001$). Comparison of subjects with ischemic and hemorrhagic stroke was presented in Table 1. No death among 1620 subjects with transient ischemic attacks was reported. The general mortality in stroke was 8.78% and in all-vascular subjects — 6.6%. In non-vascular groups we noted 24 deaths among 2070 subjects (mortality rate 1.16%). Patients with stroke (regardless of etiology) had significantly higher mortality compared to other neurological disorders (OR=11.08 95% CI 7.7–15.9, $p < 0.0001$). Baseline neurological diagnosis of all patients who died was presented in Figure 1.

Table 1. Comparison of the selected baseline parameters obtained in subjects with ischemic and hemorrhagic stroke

Parameter	Ischemic stroke N=238	Hemorrhagic stroke N=159	P — values
Age, median (range)*	74.8 (41–102)	70.6 (35–95)	0.3761
Sex, male, N (%)**	104 (43.7%)	77 (48.4%)	0.4358
Hypertension, N (%)**	195 (81.9%)	154 (96.9%)	0.3862
Diabetes, N (%)**	126 (52.9%)	67 (42.1%)	0.6862
Hyperlipidemia, N (%)**	112 (47%)	73 (45.9%)	0.8385
Smoking, N (%)**	108 (45.3%)	68 (40.2%)	0.5699
Ischemic heart disease, N (%)**	34 (14.3%)	10 (6.3%)	0.0129
Atrial fibrillation, N (%)**	108 (45.4%)	24 (15%)	0.0001
NIHSS at admission, median (range)*	12 (2–32)	14 (4–34)	0.2518
mRS at admission, median (range)*	4 (1–5)	4 (3–5)	0.1253
Death < 24 hours, N (%)**	14 (5.9%)	43 (27%)	0.0001
Infection, N (%)**	52 (21.8%)	34 (21.4%)	0.8634
Day of death, median (range)*	5.1 (1–82)	3.7 (1–46)	0.0894

*Mann–Whitney U test; **chi-square test; NIHSS — National Institute of Health Stroke Scale; mRS — modified Rankin Scale

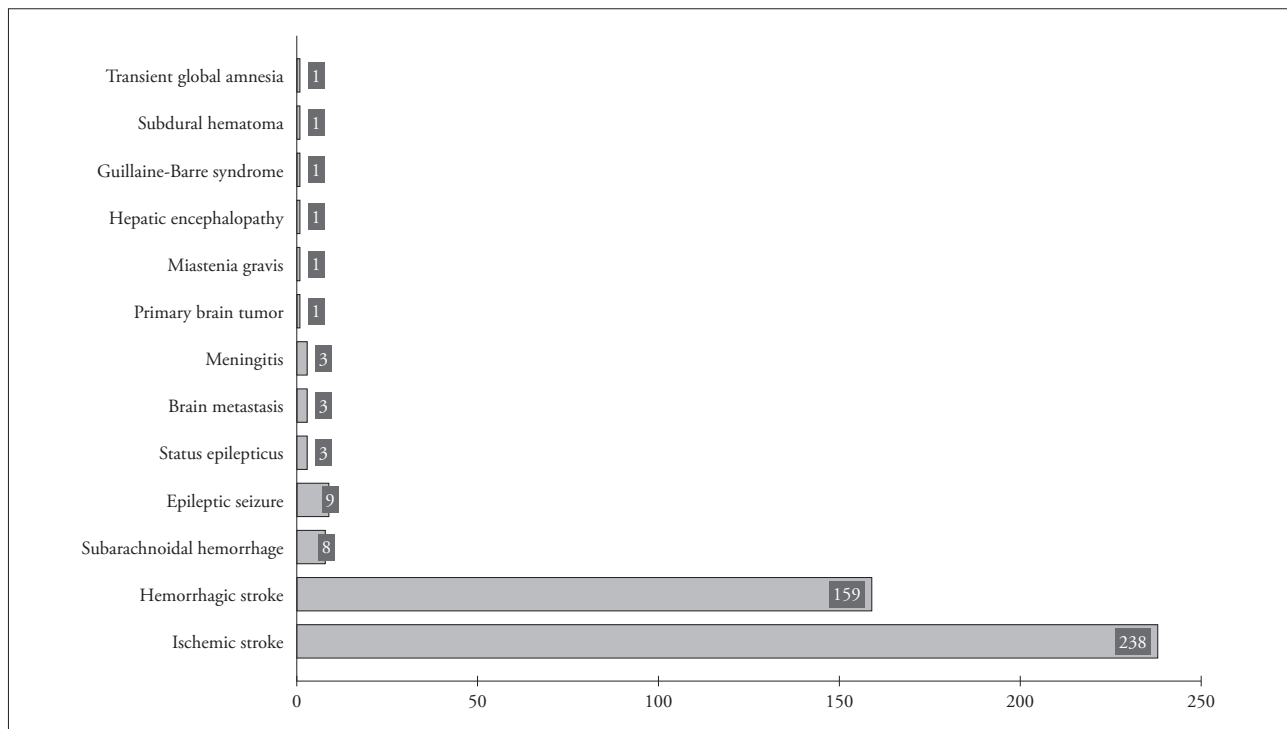


Figure 1. Number of subjects who died with specific neurological baseline diagnosis

Clinical Condition

Of all patients who died only 2 of them (0.5%) were able to walk alone at admission. 172 subjects (40%) were conscious, but they developed movement disorders that made them unable to walk alone. 255 subjects (59.5%) had conscious disturbances from the beginning. In the last group the most common type of unconsciousness was coma — 126 subjects (49.4%), than somnolence — 75 subjects (29.4%) and spoor — 54 (21.2%).

Direct Cause of Death

The most common direct cause of death was respiratory and circulatory arrest in the course of raised intracranial pressure syndrome. It was reported in 343 (80%) of all cases, in particular in stroke (94%). It was estimated as a main, primary cerebral, direct reason of death.

The other reasons, noted in 86 (20%) of all cases, have been identified as non-cerebral, direct causes of death (Figure 2).

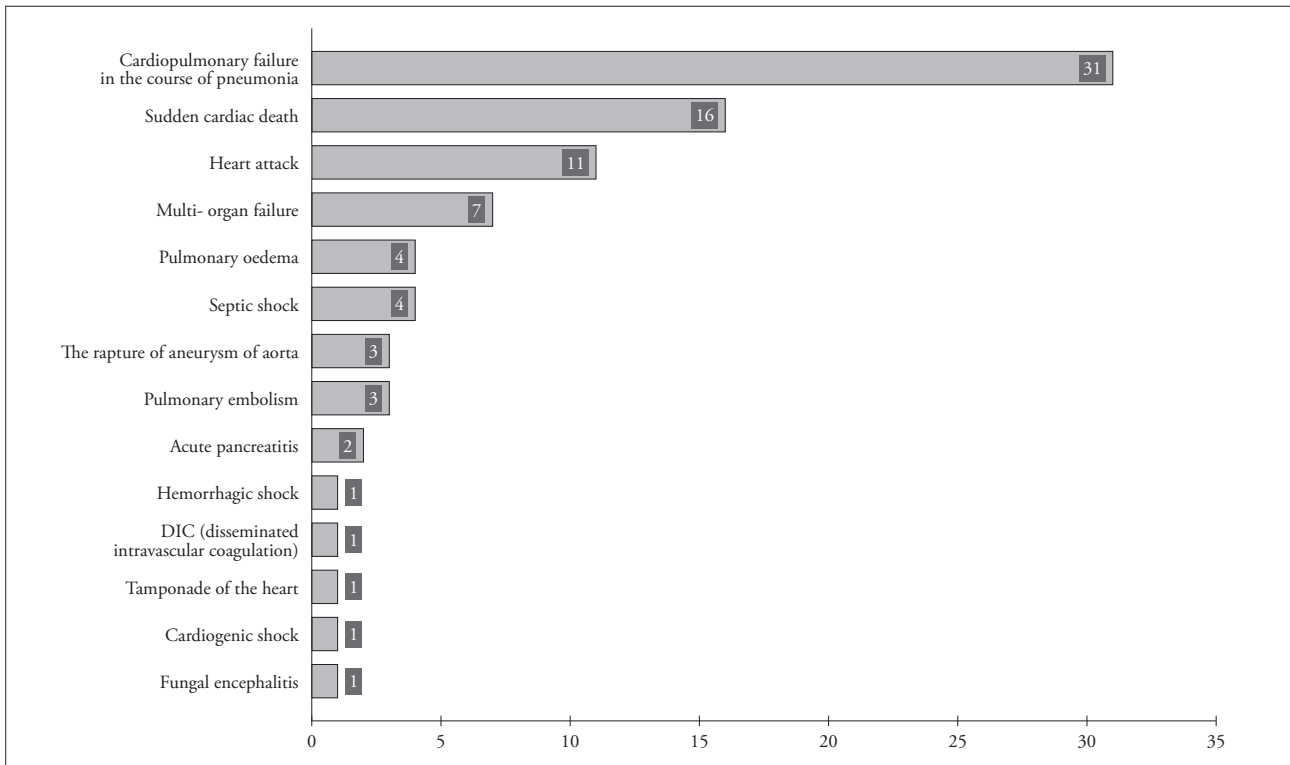


Figure 2. Number of subjects with specific, direct, non-cerebral, causes of death

Autopsy Examination

In 45 (10.5%) of all cases the autopsy examination was performed to confirm the cause of death. Only in one case of the sudden death, after autopsy examination, the unexpected cause of death was detected (bacterial meningitis), that has not been taken under consideration based on clinical diagnosis. In the other cases the sectional diagnosis coincided with the clinical diagnosis.

Death and the Time of Hospitalization

Of all cases we noted that 63 subjects (14.7%) died less than 24 hours from admission to the hospital. The most common reason of death on first day of hospitalization was the hemorrhagic stroke — 43 subjects (68%) and then the ischemic stroke in 14 (22.2%) subjects. Subjects with hemorrhagic stroke had higher risk of mortality on first day of disease compared to ischemic stroke subjects (OR=5.93, 95% CI 3.1–11.3, $p < 0.0001$). The median time of death was 4,2 days. The shortest time was one hour and twenty five minutes after admission and the longest was 82 days after admission.

Sudden, Unexpected Deaths

Of all cases of death — 30 (7%) have been considered as a sudden, unexpected death of unknown cause. In most cases of sudden, unexpected death — the cardiological reason in the autopsy examination has been found — sudden cardiac death in 16 subjects (53%) or heart attack in 9 subjects (30%).

Death Due to the Complications During Hospitalization

We reported 46 cases (10.7%) of expected death, but related to complications that occurred during hospitalization. The direct cause of death in these cases have not been primary cerebral. The most common reason was cardiopulmonary failure in the course of in-hospital pneumonia noted in 31 subjects (67.4%).

Death and the Gender

Among all cases, deaths were more common in females — 231 subjects (53.8%) than in males — 198 subjects (46.2%). In ischemic stroke females were the dominant subgroup — 134 subjects (56.3%), as well as in hemorrhagic stroke — 82 subjects (51.6%). Conversely, in other non — stroke causes of death males were the dominant group — 18 subjects (56.3%).

Death and the Age

The median age was 72.6 years old. The youngest subject was 35 years old and the oldest was 102 years old.

Death and Infections

Pneumonia has been reported as the most common infectious disease, that occurred in 94 subjects (21.9%). It is worth to notice that in almost one third of these patients (31.9%) pneumonia was considered as the main cause of death, affecting the cardiopulmonary failure.

The other infections had significantly lower incidence: urinary infections occurred in 43 subjects (10%), bronchitis in 7 subjects (1.6%), blood bacteraemia in 4 subjects (0.9%), meningitis in 3 subjects (0.7%) and sepsis — in 3 subjects (0.7%). In general, infectious factor was associated with 154 cases of death (35.9%).

Death and Specific Treatment of Ischemic Stroke

Among all cases of ischemic stroke in 35 subjects (14.7%) the specific treatment — intravenous thrombolysis — was performed. In 12 cases of them (34.3%) it has been reported the secondary bleeding related to treatment. In 3 subjects (1.3%) the mechanical trombectomy was performed and in 6 subjects (2.5%) both the above specific methods of treatment were used — in all cases secondary bleeding has not been noted.

Death and Oral Anticoagulants

Among all cases of hemorrhagic stroke in 48 cases (30.1%) the occurrence of intracranial bleeding was associated with taking oral anticoagulants. The most common drug was warfarin in 30 subjects (62.5%), then acenocumarol in 8 subjects (16.7%) and NOAC (new oral anticoagulants) in 10 subject (20.8%). In most cases of patients taking standard oral anticoagulants the blood parameter INR was elevated over normal value 3.0 (in 24 subjects — 63.2%).

Discussion

This retrospective study in the period of 5 years showed that mortality rate in Polish Neurology Ward is 5.2%. This is consistent with results reported by Velasquez-Perez et al. [5], who presented the mortality rate at 4.9%. It proves that neurological patients require special care due to the high risk of death. The major

cause of death In Neurology Ward is definitively stroke, especially hemorrhagic type. Mortality rate for stroke subjects achieved in this study are similar compared to results noted by Wong et al. [6] (ischemic stroke — 8.8%, hemorrhagic — 29.8%) and Basri et al. [7] (ischemic stroke — 11.7%, hemorrhagic — 27.3%) and slightly higher than reported by Baptista et al. [8] (ischemic — 3.7%, hemorrhagic — 14.4%). The general mortality of stroke in this study also coincide with data ranges given by other researchers. We demonstrated higher mortality compared to Koennecke et al. [9] — 5.4%, Heuschmann et al. [10] — 4.9% and Baptista et al. [8] — 4.8% and lower mortality than Sabin [11] — 12.9% and Basri et al. [7] — 15.1%. The author believes that divergent results may be related to imbalanced etiological types of stroke in individual population — the higher the incidence of hemorrhagic stroke, the higher the general mortality. This study underlines that other neurological disorders, except for stroke, are related to low mortality rate.

It is worth to notice that the initial poor clinical condition at admission, in particular consciousness disturbances, is associated with higher mortality. Almost all patient who died were unable to walk alone (99.5%) and most of them (59.5%) were unconscious during the initial examination. However, it was not demonstrated that initial clinical condition, expressed on NIHSS and mRS scores, differed significantly among hemorrhagic and ischemic stroke.

The most common direct cause of death was primary cerebral as a result of raised intracranial pressure, in particular, in stroke subjects. The same value (94%) was reported in stroke patients by Heuschmann et al. [10]. It is important to highlight that the most common, non — cerebral, direct cause of death were acute cardiological disorders (sudden cardiac death, heart attack, pulmonary oedema or cardiogenic shock) and acute cardiopulmonary failure in the course of pneumonia.

This study showed that average time of death was similar to the results presented by other authors [7,10]. The results are also generally consistent with the data from literature that show that one third of subjects will die in three days after the onset of stroke and two-thirds will die within one week [10]. Despite the fact, that hemorrhagic stroke significantly more often than ischemic stroke led to death on first day of disease, there were no significant differences in time of death between the two etiological types of stroke. In contrast, Basri et al. [7] reported that the average time of death in ischemic stroke is significantly longer compared to hemorrhagic stroke (8 days vs. 3.8 days).

The study showed that the percentage of the sudden, unexpected deaths in neurological disorders is relatively low and the vast majority is associated with acute cardiological disturbances.

This study highlights a significant role of coexisting infections in increasing mortality risk among neurological patients. Co-occurrence of infections was noted in this research in one third of subjects who died. Pneumonia seems to have been the most dangerous. The incidence of pneumonia was in the ranges suggested by other authors [9,10] (from 12.2% to 31.2%), but in this study it was underlined that in one third of subjects pneumonia significantly contributed to death resulting in acute cardiopulmonary failure as a direct cause. Accurate rapid diagnosis and proper treatment of infectious diseases as soon as possible may reduce the mortality among neurological subjects.

The author draws attention to the iatrogenic aspect related to the mortality in stroke subjects. In one third of patients, thrombolytic treatment led to the secondary bleeding and could have contributed to death. The percentage of deceased patients with whom the thrombolytic treatment was performed was higher than reported by Reed et al. [12]. Despite the fact that thrombolytic treatment brings much more benefits, it should be remembered about disadvantages and side effects. A similar issue applies to oral anticoagulants that effectively protect against thromboembolic complications. On the other hand, as presented in this study, in almost one third of cases, they may have resulted in the fatal hemorrhagic stroke. Unfortunately, the above data show, that in addition to effectiveness, the drugs may be deadly dangerous.

Anthropometric characteristics of subjects in this study was similar to the data shown by Bacellar et al. [13]. Female was the dominant gender, but with no statistically significance in stroke subjects. The median age was also similar to the data presented in literature [14].

Conclusions

Despite the significant advances in treatment, stroke, especially hemorrhagic subtype, still remains the cause of the highest in-hospital mortality in the Neurology Ward. In most cases a direct cause of death is primary cerebral as a result of baseline neurological diagnosis, but despite better standards of care in Stroke Unit, the percentage of deaths in the course of in-hospital complications still remains too high. It is worth to notice that special attention should be paid to patients with coexisting infectious diseases, in particular pneumonia, resulting in increasing mortality rate among neurological patients.

Implications for Nursing Practice

This study highlights the severity of clinical cases that occur in the Neurology Ward and underlines that stroke still remains neurological disorder with the highest mortality.

Nurses, especially in Stroke Units, must have skills of caring of patients who are in a life-threatening conditions, as well as psychological properties for communing with death. Greater attention should be paid to the early signs of infection, in particular from respiratory track, of which serious life-threatening complications may develop.

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Corresponding Author:

Adam Wiśniewski

Department of Neurology, The University Hospital No. 1, Collegium Medicum, Nicolaus Copernicus University Skłodowskiej 9 street, 85-094 Bydgoszcz, Poland

e-mail: adam.lek@wp.pl

ORCID: 0000-0001-5839-0126

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