

ORIGINAL PAPER/ARTYKUŁ ORYGINALNY

Statistical analysis of the intracranial procedures in Poland in 2008-2009

Analiza statystyczna zabiegów wewnątrzczaszkowych przeprowadzonych w Polsce w latach 2008–2009

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Neurologia i Neurochirurgia Polska 2012; 46, 4:

DOI: 10.5114/ninp.2012.29565

Abstract

Background and purpose: Quantitative and qualitative analysis of neurosurgical procedures provides important data for assessment of the development and trends in the field of neurosurgery. The authors present statistical data on intracranial procedures (IPs) performed in Poland in 2008-2009.

Material and methods: Data on IPs come from reports of the National Health Fund, grouped according to the system of Diagnosis-Related Groups, group A – nervous system diseases. Data concerning the year 2009 include all IPs performed in Poland. Data from the second half of 2008 to 2009 (18 months) come from 35 neurosurgical centers in Poland, divided by provinces. We analyzed the number of IPs, the cost of procedures, duration of hospitalization and deaths.

Results: 20 849 IPs were performed in Poland in 2009. The most common procedure was A12 (6807; 32.65%), and the rarest was A04 (96; 0.46%). The annual cost of all IPs was 228 599 956 PLN. Average cost of the procedure ranged from 1578 PLN (A14) to 47 940 PLN (A03). Duration of the hospitalization ranged between 3 days (A14) and 12 days (A12). The highest percentage of deaths was reported for A01 ($n = 1050$, 19.06%). Reports from 35 neurosurgical centers in the second half of 2008 and 2009 showed the highest number of IPs per 100 000 population in Kujawsko-Pomorskie (93) and the lowest in Wielkopolskie (27) and

Streszczenie

Wstęp i cel pracy: Analiza ilościowa i jakościowa procedur neurochirurgicznych dostarcza istotnych danych dotyczących rozwoju oraz trendów w dziedzinie neurochirurgii. Autorzy pracy przedstawiają dane statystyczne dotyczące procedur wewnątrzczaszkowych (PW) wykonywanych w Polsce w latach 2008–2009.

Materiał i metody: Dane dotyczące PW pochodzą z raportów Narodowego Funduszu Zdrowia i były grupowane wg systemu Jednorodnych Grup Pacjentów dla grupy A – choroby układu nerwowego. Dane z 2009 r. uwzględniają wszystkie PW wykonane w Polsce, dane z drugiej połowy 2008 i 2009 r. (18 miesięcy) pochodzą z 35 ośrodków neurochirurgicznych w Polsce podzielonych według województw. Analizowano liczbę PW, koszty procedur, czas hospitalizacji i liczbę zgonów.

Wyniki: W 2009 r. w Polsce wykonano 20 849 PW. Najczęstszą procedurą była A12 (6807; 32,65%), a najrzadszą A04 (96; 0,46%). Roczny koszt wszystkich PW wyniósł 228 599 956 PLN. Średni koszt procedury wahał się od 1 578 PLN (A14) do 47 940 PLN (A03). Czas hospitalizacji wahał się od 3 dni (A14) do 12 dni (A12). Największy odsetek zgonów odnotowano dla procedury A01 (19,06%; $n = 1050$). Analizowano raporty 35 ośrodków neurochirurgicznych w Polsce. W ciągu 18 miesięcy (druga połowa 2008

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Received: 23.07.2011; accepted: 25.01.2012

Podkarpackie (27). The highest number of IPs (1669) was performed in neurosurgical center M1 (Małopolskie), and the lowest (99) in W1 (Wielkopolskie).

Conclusions: A significant disparity in the number of IPs performed in different centers in Poland was observed. There are no data in the literature on the number of neurosurgical procedures performed in Poland in other periods.

Key words: neurosurgical procedures, Poland, statistical analysis.

i 2009) najwięcej PW na 100 tys. mieszkańców wykonano w kujawsko-pomorskim (93), natomiast najmniej w wielkopolskim (27) i podkarpackim (27). Najwięcej PW (1669) wykonano w ośrodku M1 (małopolskie), najmniej (99) w W1 (wielkopolskie). Najczęściej raportowana była procedura A12. **Wnioski:** Obserwowano znaczną dysproporcję w liczbie PW wykonywanych w różnych ośrodkach w Polsce. Brakuje danych w piśmiennictwie dotyczących liczby procedur neurochirurgicznych wykonywanych w Polsce we wcześniejszych okresach.

Słowa kluczowe: procedury neurochirurgiczne, Polska, analiza statystyczna.

Introduction

Data concerning the quantitative, qualitative and cost-effectiveness analysis of neurosurgical procedures, in addition to purely clinical knowledge, is of significant value for practicing neurosurgeons. Neurosurgery, as a highly specialized branch of medicine, should meet the criteria for appropriate territorial distribution, provide a high quality service, be associated with and supported by scientific research and be properly funded. Analysis of neurosurgical procedures in certain years, or longer periods of time, allows one to track trends, both resulting from natural morbidity and from changes in the profile of the services provided by neurosurgical centers. In addition, transparent analysis of procedures in different centers and regions gives a reliable view on the development of neurosurgery and its availability. Reports compiled and authorized by a neurosurgical society and experts are based on a more practical and useful approach and are gaining in importance when compared to data from official healthcare statistics or insurance companies. In recent decades due to the rapid development of endovascular pro-

cedures and neuroradiology a decline in the number of intracranial procedures (IPs), especially in vascular neurosurgery, both in Poland and worldwide, has been observed.

The authors present qualitative and quantitative analysis of intracranial procedures carried out in the neurosurgical centers in Poland in 2008-2009, including data from 35 neurosurgical centers.

Material and methods

The present statistical analysis refers to the intracranial procedures performed in Poland in the second half of 2008 and 2009 (18 months). These procedures are grouped according to the system of Diagnosis-Related Groups (DRG) (*Jednorodne Grupy Pacjentów, JGP*), as proposed by the National Health Fund (*Narodowy Fundusz Zdrowia, NFZ*). Procedures from group A – *Diseases of the nervous system* – were analyzed in this study (Table 1). Group A04 includes, in addition to *replacement of deep brain stimulator* also *implantation/replacement of spinal cord stimulator*, which is not an intracranial procedure. Due to the lack of accurate data in this group, the study includes all the procedures from group A04, both spinal and intracranial. Data from 2009 have been modified for the requirements of this study and derive from the official statistical database of NFZ published on the website [1]. Data on the number of IPs in the second half of 2008 and 2009 take into account the division into voivodships (provinces) and neurosurgical centers accredited for specialty training in the field of neurosurgery. These come from the official correspondence with the NFZ and do not include Podlaskie and Pomorskie Voivodship. Each neurosurgical center was labeled with the first letter of the name of the voivodship and a number of order. For A01,

Table 1. Diagnosis-Related Groups (*Jednorodne Grupy Pacjentów, JGP*); Group A – Diseases of the nervous system

A01 – Intracranial procedures for severe trauma
A02 – Intracranial procedures for trauma
A03 – Implantation of deep brain stimulator
A04 – Implantation/replacement of spinal cord stimulator or replacement of deep brain stimulator
A11 – Complex intracranial procedures
A12 – Large intracranial procedures
A13 – Medium intracranial procedures
A14 – Small intracranial procedures

A10 and A11 DRG groups, a detailed analysis of the procedures by ICD-9 was given.

In a pooled analysis of IPs in 2009, the number of procedures, length of hospitalization, the average cost of procedure and mortality were presented.

Results

A total of 20 849 IPs were performed in Poland in 2009. The most common procedure was A12, reported 6807 times (32.65%), and the rarest was A04 – 96 (0.46%) (Table 2). The average cost of the procedure ranged from 1578 PLN (A14) to 47 940 PLN (A03).

The annual cost of all IPs was 228 599 956 PLN. In aggregate the most expensive procedure per year was A11 (88 377 828 PLN) and the cheapest was A14 (747 972 PLN). The length of hospitalization (median) ranged between 3 days (A14) and 12 days (A12). The highest mortality was reported for procedure A01 with 19.06% (1050). For other procedures this rate did not exceed 11%. There were no deaths in A03 or A04.

The frequency of the procedures by ICD-9 in groups A01, A11 and A12 are shown in Table 3. In group A01 about half of the procedures (44.7%, 2463) were *craniotomy with removal of subdural hematoma*. The most common procedure in group A11 was *incision of the brain tissue* reported 1744 times (30.7%), then *repair of brain* – 619 (10.9%), and *excision of cerebral meninges* – 568 (10%). Transsphenoidal resection of pituitary tumours was reported 546 times (9.6%) and *excision of acoustic neuroma* 227 times (4%). The number of aneurysm clipping procedures was 540 (9.5%), while adding all possible ICD-9 procedures relating to the surgical treatment of aneu-

rysms (aneurysm thrombosis – 63; ligation – 57; electrocoagulation – 188; wrapping – 188), the number increased to 1036. The total number of vascular procedures was 1422, including aneurysms and arteriovenous malformations of the brain (386). The available data do not clarify, however, whether more than one ICD-9 procedure related to aneurysm surgery has been reported simultaneously in one patient. The most common procedure in group A12 was *other excision of brain tumour* – 2859 (42%).

Thirty-five reports from neurosurgical centers in Poland were analyzed. In the period of 18 months (between the second half of 2008 to 2009) the highest number of IPs was performed in Mazowieckie Voivodship – 3423 and the lowest in Opolskie – 463 (Table 4). However, the number of IPs per 100 thousand population was the highest in Kujawsko-Pomorskie Voivodship (93), while in Wielkopolskie (27) and Podkarpackie (27) the lowest, data on other voivodships are shown in Table 4. The most neurosurgical procedures were performed in M1 – 1669 (Małopolskie), then K1 – 1101 (Kujawsko-Pomorskie), L1 – 1095 (Lubelskie) and the least in W1 – 99 (Wielkopolskie). A12 was the most commonly reported procedure (in 20 centers), then A11 (10 centers) and A01 (5 centers). Procedure A11 was most often reported in M1 – 810 (Małopolska), A12 in K1 – 957 (Kujawsko-Pomorskie), A01 in M1 – 436. Procedure A03 was performed in 10 centers, and A04 in 18 centers.

Discussion

There is a lack of statistical data in the literature related to neurosurgical procedures in Poland. Comparison of the present results with data from other years was unfea-

Table 2. Characteristics of intracranial procedures in Poland in 2009 by Diagnosis-Related Groups (*Jednorodne Grupy Pacjentów, JGP*)

	A01	A02	A03	A04*	A11	A12	A13	A14
<i>n</i>	5510	595	198	96	5682	6807	1487	474
Percent	26.43%	2.85%	0.95%	0.46%	27.25%	32.65%	7.13%	2.27%
Length of hospitalization [days], median	9	9	5	8	11	12	8	3
Average cost of the procedure (PLN)	7800	7140	47940	31875	15554	10383	6065	1578
Deaths, <i>n</i>	1050	26	0	0	441	720	115	7
Deaths, %	19.06	4.37	0	0	7.76	10.58	7.73	1.48
Annual cost of the procedure (PLN)	42978000	4248300	9492120	3060000	88377828	70677081	9018655	747972

*This group includes implantation/replacement of spinal cord stimulator

Table 3. Characteristics of intracranial procedures by International Classification of Diseases, 9th edition (ICD-9) in Poland in 2009 for selected Diagnosis-Related Groups (DRG) (*Jednorodne Grupy Pacjentów, JGP*)

DRG	ICD-9	Number of procedures	% in DRG	Average length of stay (days)
A01				
Craniotomy with removal of subdural haematoma	01.247	2463	44.7	13.72
Trephination (<i>trepanation</i>)	01.243	1333	24.2	11.56
Craniotomy with removal of epidural haematoma	01.245	788	14.3	13.9
Aspiration of subdural space	01.092	127	2.3	11.83
Craniotomy with removal of intracerebral haematoma	01.248	116	2.1	17.82
A11				
Incision of brain tissue	01.321	1744	30.7	16.52
Repair of brain	02.92	619	10.9	15.36
Excision of cerebral meninges	01.512	568	10.0	15.21
Clipping of aneurysm	39.51	540	9.5	16.24
Partial or total excision of pituitary gland, transsphenoidal approach	07.62 + 07.65	546 (455 + 91)	9.6	8-10
Excision of acoustic neuroma	04.012 + 04.011	227 (125 + 102)	4.0	13-16
A12				
Other excision of brain tumour	01.599	2859	42.0	17.86
Ventriculoperitoneal shunt	02.342	1041	15.3	17.59
Craniotomy with removal of intracerebral haematoma	01.248	762	11.2	15.85
Excision of cerebellar tumour	01.595	374	5.5	18.1
Ventricular shunt to extracranial site (not classifiable elsewhere)	02.392	340	5.0	22.5
Percutaneous, stereotactic needle biopsy of brain	01.132	334	4.9	8.51

sible. Additionally, the definition of neurosurgical procedures according to ICD-9, which is not very precise, does not allow for the comprehensive evaluation of the data and does not adequately refer to the nature and essence of neurosurgical operations. The DRG system does not support the qualitative assessment of the procedure, but only enables the quantitative classification of operations into complex, large, medium or small procedures.

The most frequent DRG were *complex (A11)*, *large (A12) intracranial procedures* and *intracranial procedures for severe trauma (A01)*. There was a significant disparity between the number of procedures performed in various

neurosurgical centers. An annual number of 200 IPs seems a very low result, compared with centers that perform more than 1000. The question is whether neurosurgical operations, as highly specialized procedures, should be performed only in large clinical or university hospitals, or perhaps the only criterion should be a qualified medical team and appropriate equipment regardless of the scientific background and territorial distribution? The answer to this question is not the subject of this study, but it is worth stressing that the dispersion of neurosurgical centers is reflected in the disparity of IPs, and perhaps the quality of the service.

Table 4. Characteristics of intracranial procedures in 35 neurosurgical centers in 14 voivodships (excluding Pomorskie and Podlaskie) in the second half of 2008 and 2009 (18 months)

	Dolnośląskie		Kujawsko-Pomorskie			Lubelskie		Lubuskie		Łódzkie			Małopolskie			Mazowieckie				
	D1	D2	D3	K1	K2	K3	L1	LU1	LU2	Ł1	Ł2	Ł3	M1	M2	MA1	MA2	MA3	MA4	MA5	MA6
A01 Intracranial procedures for severe trauma	110	128	207	34	124	109	99	90	82	26	43	129	436	142	119	125	219	93	169	72
A02 Intracranial procedures for trauma	9	9	13	6	22	10	7	4	3	5	13	20	113	9	5	26	27	24	22	18
A03 Implantation of deep brain stimulator	0	0	0	33	0	–	20	0	0	0	0	7	9	0	0	0	0	0	9	0
A04 Implantation/replacement of spinal cord stimulator or replacement of deep brain stimulator	5	0	0	20	0	–	5	0	9	1	1	1	3	8	0	0	0	0	0	0
A11 Complex intracranial procedures	2	149	15	345	34	12	698	153	38	6	45	321	810	24	197	353	55	421	31	391
A12 Large intracranial procedures	165	284	264	597	270	207	218	27	159	207	78	196	200	179	103	53	334	46	72	250
A13 Medium intracranial procedures	19	42	32	61	25	7	36	15	7	95	24	85	82	32	30	17	55	30	24	13
A14 Small intracranial procedures	0	2	1	5	4	–	12	3	0	4	1	4	16	3	1	2	7	10	1	0
Total	310	614	532	1101	479	345	1095	292	298	344	205	763	1 669	397	455	576	697	633	319	743
Total number of procedures in voivodship	1456			1925			095	590		1312			2066							3423
Population of voivodship*	2 876 627			2 069 083			2 157 202	1 010 047		2 541 832			3 287 136							5 222 167
Number of procedures per 100 000 inhabitants	51			93			51	58		52			51							51

*Data of Central Statistical Office, 2009

Table 4. Cont.

	Opolskie		Podkarpackie			Śląskie			Warmińsko-Mazurskie			Świętokrzyskie			Wielkopolskie			Zachodniopomorskie	
	O1	P1	S1	S2	S3	S4	S5	SW1	W1	W2	WL1	WL2	WL3	Z1	Z2				
A01 Intracranial procedures for severe trauma	173	190	17	154	137	127	166	318	146	86	119	64	64	91	195				
A02 Intracranial procedures for trauma	17	32	11	17	13	10	13	10	8	4	9	5	9	3	25				
A03 Implantation of deep brain stimulator	9	0	0	18	0	0	10	0	0	74	0	0	0	2	0				
A04 Implantation/replacement of spinal cord stimulator or replacement of deep brain stimulator	0	2	0	3	0	4	1	2	0	0	0	2	2	4	1				
A11 Complex intracranial procedures	161	64	38	218	81	31	251	216	27	0	83	72	4	266	276				
A12 Large intracranial procedures	83	265	92	462	20	139	360	328	231	60	286	104	9	37	254				
A13 Medium intracranial procedures	19	21	61	73	7	11	23	21	33	18	19	39	10	29	94				
A14 Small intracranial procedures	1	3	3	2	0	2	2	0	17	2	1	4	1	1	2				
Total	463	577	222	947	258	324	826	895	462	244	517	290	99	433	846				
Total number of procedures in voivodship	463	577					2 577	895	706		906			1 279					
Population of voivodship*	1 031 097	2 101 732					4 640 725	1 427 118	1 270 120		3 408 281			1 693 198					
Number of procedures per 100 000 inhabitants	45	27					56	70	49		27			51					

*Data of Central Statistical Office, 2009

Table 5. Characteristics of selected neurosurgical procedures in the United States in 1993 and 2005-2007

	1993	2005	2006	2007	Difference (%) 1997-2007
Craniotomy for tumour	50,963	69,046	64,898	70,849	39%
Craniotomy for other purposes	44,092	52,928	55,436	56,405	28%
Craniotomy for vascular surgery	4089	2119	1945	2237	-45%
Spinal fusion	54,463	27,549	342,945	350,287	543%
Ventricular shunts	38,314	52,539	47,094	45,846	20%
Deep brain stimulation	890	4408	4557	4137	365%

Neurosurgical procedures from group A11 are reimbursed at 15 000 PLN. When assessing the complexity of procedures reported in this group, especially in skull base tumours, aneurysms or vascular malformations, the level of reimbursement is inadequate regarding the skills and qualifications required for these procedures, duration of the operations, and the application of highly specialized equipment such as neuronavigation, microscope, and intraoperative magnetic resonance.

In the United States, the expected growth rate of craniotomies for brain tumours or other non-vascular indications was estimated at about 2700/year; on the other hand, there is a prognosis of the reduction in implantation of shunt systems by 3000/year (Table 5). A decrease in vascular surgery was noted due to the dynamic development of endovascular procedures (by 29% in 2004-2007). The average length of hospitalization was as follows: craniotomy for tumour – 7.3 days; craniotomy for vascular surgery – 7 days, deep brain stimulation – 4.4 days [3].

The report of Section of Neurosurgery-UEMS (*Union des Médecins Spécialistes Européenne*) published in 2009 provided an interesting analysis of neurosurgical procedures in the European Union [4]. According to these data, the number of neurosurgical procedures per 100 000 inhabitants in Poland is 77 (against a European average of 164); this is the lowest index of all evaluated countries. The leading countries are Luxembourg (360), the Czech Republic (260), and Austria (250). The number of inhabitants per one neurosurgeon for Poland is 118 000, with a European average of 99 000. This rate is the highest in the United Kingdom (294 000) and the Netherlands (151 000). Another analyzed factor was the number of operations performed by a neurosurgeon per year, which is 70 in Poland (European average – 154), and the highest is in the United Kingdom (300 per year).

Conclusions

1. A considerable disparity in the number of intracranial procedures between various centers in Poland was observed.
2. Reporting of intracranial procedures in accordance with ICD-9 and DRG does not accurately reflect the range and type of neurosurgical procedures.
3. Reports on qualitative and quantitative analysis of neurosurgical procedures and trends in various periods in Poland are lacking.

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