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Effects of epidural analgesia on the course of labor

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Abstract. – OBJECTIVE: The aim of this study was to assess the effects of epidural analgesia on the course of labor.

SUBJECTS AND METHODS: The material for the study was obtained from the analysis of 300 medical records of patients delivering under epidural analgesia in the period 2015-2019. A questionnaire by the authors was used as the research tool. Statistical analysis was performed using Fisher's test, Pearson's Chi-square test of independence, and Cramer's V-test.

RESULTS: The first stage of labor in primiparas usually lasted six to nine hours, and in multiparas under five hours ($p = 0.041$). The second stage was shorter in multiparas ($p < 0.001$). Our five-year analysis demonstrated that the second stage of labor was longer from year to year ($p = 0.087$). The fetal station had an effect on the duration of the first stage of labor ($p = 0.057$). After administration of epidurals, the majority of the women bore the pain well ($p = 0.052$).

CONCLUSIONS: Epidural analgesia reduces labor pain, but may also disturb the natural rhythm of labor. This happens even if the moment of application of the analgesia is chosen with the guidance of obstetric indications, and may result in the necessity for surgical intervention.

Key Words:
Epidural analgesia, Labor pain, Course of labor, Cervical dilation, Fetal station, Primipara, Multipara.

Introduction

Childbirth is a series of successive processes aimed at expelling the fetus from the uterus. According to the World Health Organization, the primary goal of care provided during natural labor is to ensure the good health of the mother and her baby with the least possible medical intervention.

Epidural analgesia is considered the most effective and safest form of pharmacological labor pain relief. Although it has gained the approval of both the medical community and parturients, it is not a standard procedure in all centers[1-4]. First documented over 50 years ago, epidural analgesia is currently used during labor in the case of 20-30% of parturients in developed countries[5-7]. At the beginning of the twenty-first century, it was given to about 50% of parturients in the USA, and from 20% to over 80% of delivering women in Europe[8].

Pain is a complex issue and may be interpreted in many ways. Though initially seen as a purely psychological phenomenon, with the development of neuroanatomy and neurophysiology, it began to be considered an exclusively sensory experience. Over the years, multidisciplinary research has changed pain perception. Currently, it is regarded a psychosomatic phenomenon which, aside from somatic elements, has also cognitive and emotional aspects[5]. Pain accompanies people from birth to death and is the most frequently experienced sensation. Since the dawn of humankind, people have thus sought ways to alleviate or eliminate it[5,6,9,10].

Most women experience severe pain during childbirth. Although this is a physiological phenomenon, there is no reason to force a woman to go through it. Modern medicine offers a range of methods to reduce pain[11], both natural and pharmacological ones. An interesting option is immersion in water during labor, which has been popularized over the past several decades. Nevertheless, there are insufficient data to draw conclusions about the relative benefits and risks of immersion in water during the second stage of labor and delivery. Hence, the recommendation of The American College of Obstetricians and

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Gynecologists (ACOG) is that birth should occur on land, not in water until such data are available[12]. According to the College, "a woman who requests to give birth while submerged in water should be informed that the maternal and perinatal benefits and risks of this choice have not been studied sufficiently to either support or discourage her request. She also should be informed of the rare but serious neonatal complications associated with this choice"[12]. The use of epidurals is not completely free of risks, either. Based on their study conducted among 37,786 parturient women, Jia et al[13] found that receipt of epidural analgesia in labor was associated with an increased risk of neonatal infection and a higher risk of maternal intrapartum fever and histologic chorioamnionitis. What is worth emphasizing, however, is the fact that the overall incidence of neonatal infection was low and the observed neonatal infections were neither associated with increased morbidity nor with mortality. This was consistent with the previous studies[14] showing that epidural analgesia is not associated with worse Apgar scores or neonatal intensive care unit admissions (NICU). As stated by Silva et al[15], epidural analgesia is an extremely effective treatment for labor pain and the incidence of side effects is low. There are, however, some contraindications to the technique, including severe coagulopathy and infection at the site of puncture. The ACOG and the American Society of Anesthesiologists (ASA) state that "there is no other circumstance in which it is considered acceptable for an individual to experience untreated severe pain that is amenable to safe intervention while the individual is under a physician's care. In the absence of a medical contraindication, maternal request is a sufficient medical indication for pain relief during labor" [16,17].

The nature and intensity of labor pain depends on the stage of labor, its duration and intensity, the neural pathways involved in pain perception, and psychological and sociocultural determinants[18,19]. Acute pain and severe stress lead to a decrease in uteroplacental flow, which manifests as abnormal uterine contractile activity, thus prolonging labor[18,20]. Although labor pain is not life-threatening for healthy parturients, it may lead to serious neurological and psychological problems[21,22].

Since medicine strives to completely eliminate suffering, alleviating labor pain has become a priority for anesthesiologists[1-4,23,24]. Practice guidelines for obstetric anesthesia developed by the American Society of Regional Anesthesia (ASRA) read: "When sufficient resources (…) are available, neuraxial catheter techniques should be one of the analgesic options offered"[25].

The aim of this study was to analyze the effects of epidural analgesia on the course of labor. We adopted the following research hypotheses: 1) epidural analgesia reduces labor pain; 2) the moment of administration of epidural analgesia (cervical dilation, the fetal station), guided by internal obstetric examination, has an impact on the duration of the first and the second stages of labor; 3) epidural analgesia neither affects the course of the third stage of labor nor leads to complications in it; 4) there is no link between the use of epidural analgesia and the need for blood or blood product transfusions.

Subjects and Methods

The research was conducted from November to December 2019, and was based on the analysis of medical records of 300 patients giving birth under epidural analgesia in the Independent Public Clinical Hospital No. 1, Pomeranian Medical University of Szczecin, in Police in 2015-2019. The patients' documentation was analyzed after obtaining the consent of the head of the Department of Perinatology, Obstetrics and Gynecology, the director of the hospital, and the head of the archives.

Our study focused on three aspects, namely: 1) pain after analgesia; 2) duration of the first and the second stage of labor in primiparas and multiparas; 3) complications of the third stage of labor. It was performed using a self-developed questionnaire completed by the authors based on the documentation analysis. The issues taken into account were:

1. Sociodemographic data (age of the pregnant woman, gravida and parity, week of gestation, estimated fetal weight, and whether it was an induced or spontaneous delivery).
2. The first stage of labor:
   - ways to alleviate pain used prior to administration of analgesia (relaxants, non-pharmacological methods);
   - uterine contractile activity (Oxytocin);
   - the level of pain before the use of analgesia (tolerates well, controls herself, excited);
   - internal obstetric examination – cervical dilation (< 4 cm, 4-5 cm, > 5 cm);
   - internal obstetric examination – fetal station (-4 -3), (-2 -1), (≥ 0);

- feeling pain after the use of analgesia (tolerates well, controls herself, excited);
- the duration of the first stage in primiparas (≤ 5 h, 6-9 h, 10-15 h, > 15 h);
- the duration of the first stage in multiparas (≤ 4 h, 5-7 h, 8-9 h, > 9 h).

3. The duration of the second stage of labor in primiparas (≤ 30 min, 31-60 min, 61-90 min, 91-120 min) and multiparas (≤ 15 min, 16-30 min, 31-60 min).
4. The third stage of labor:
   - the duration of the third stage of labor in primiparas (≤ 15 min, 16-30 min, > 30 min) and multiparas (≤ 5 min, 6-15 min, > 15 min);
   - medications used (Methergina, Pabal, others);
   - procedures performed (revision of the uterine cavity, manual removal of the placenta).
5. The fourth stage of labor:
   - blood loss;
   - complications (hypotonia, hemorrhage, etc.);
   - medications used for hemorrhage (Methergina, Pabal, others);
   - transfusion of blood or blood products.

Statistical Analysis

Statistical calculations and processing of the results were performed using the SPSS v. 24 statistical package (IBM Corp., Armonk, NY, USA). Mathematical statistics such as distribution fit tests and significance of difference tests were also used. The following tests were employed: Fisher's test, Pearson's Chi-square test of independence, Cramer's V. The level of significance was set as $p = 0.05$.

Results

The study involved 300 women, whose mean age was 28.68 ± 4.880 (M ± SD) years. The youngest respondent was 17 and the oldest 41.

Among the parturients, primiparas constituted an overwhelming group of 242 (80.67%) women, while every fifth woman was a multipara. The lowest number of pregnancies and deliveries was one, while the highest was six. On average, the women were in the 39th week of gestation, and lost 322 ml of blood during childbirth (Table I).

In 178 (59.3%) respondents, labor began spontaneously, while in 122 (40.7%) it was induced. In 111 (44.8%) women, the first stage of labor lasted from six to nine hours, in 104 (41.9%) less than five hours, and in 33 (13.3%) from ten to fifteen hours. In 81 (34.3%) women, the second stage lasted fewer than 30 minutes, in 78 (33.1%) from 31 to 60 minutes, in 56 (23.8%) from 61 to 90 minutes, in 19 (9.8%) from 91 to 120 minutes, and in 2 (0.8%) more than 120 minutes. In 194 (91.9%) women, the third stage lasted fewer than 15 minutes, in 15 (7.1%) from 16 to 30 minutes, and in 2 (0.9%) longer than 30 minutes (Table II).

Analysis showed that out of 300 women, 113 (37.7%) lost less than 200 ml of blood, 90 (30.0%) lost 201-300 ml of blood, 72 (24.0%) lost 301-500 ml of blood, 11 (3.7%) lost 701-1000 ml of blood, 9 (3.0%) lost 501-700 ml of blood, and 5 (1.7%) lost more than 1000 ml of blood. Complications were noted in 14 women, of whom 8 (57.1%) suffered from hypotony and hemorrhage, 3 (21.4%) had hypotony, and 3 (21.4%) hemorrhage. Seven women received hemorrhage drugs, and only three (1.0%) received transfusions of blood or blood products (Table III).

Table I. Obstetric data.

		n	%		
Parity	Primipara	242	80.67		
	Multipara	58	19.33		
	Total	300	100.0		
	n	**M ± SD**	**Min-Max**	**Q1-Q3**	
Gravida	300	1.41 ± 0.760	1-6	1.00-2.00	
Parity	300	1.23 ± 0.544	1-6	1.00-1.00	
Weeks of gestation	300	39.18 ± 1.162	35-41	38.25-40.00	
Blood loss [ml]	300	322.17 ± 210.590	100-1500	200.00-400.00	

(n) number of participants, (%) percentage of participants, (M ± SD) arithmetic mean ± standard deviation, (Min-Max) minimum-maximum, (Q1) lower quartile, (Q3) upper quartile.

Table II. The type of labor onset, and the duration of 1-3 labor stages after the use of epidural analgesia.

		N	%
Type of labor onset	Spontaneous	178	59.3
	Induced	122	40.7
	Total	300	100.0
1st stage	≤ 5 hours	104	41.9
	6-9 hours	111	44.8
	10-15 hours	33	13.3
	Total	248	100.0
2nd stage	≤ 30 minutes	81	34.3
	31-60 minutes	78	33.1
	61-90 minutes	56	23.7
	91-120 minutes	19	8.1
	> 120 minutes	2	.8
	Total	236	100.0
3rd stage	≤ 15 minutes	194	91.9
	16-30 minutes	15	7.1
	> 30 minutes	2	.9
	Total	211	100.0

(N) number of participants, (%) percentage of participants.

Table III. Blood loss during labor/complications of the third stage among women who received epidural analgesia.

		N	%
Blood loss [ml]	< 200	113	37.7
	201-300	90	30.0
	301-500	72	24.0
	501-700	9	3.0
	701-1000	11	3.7
	> 1000	5	1.7
	Total	300	100.0
Complications in the third stage of labor	Hypotony	3	21.4
	Hemorrhage	3	21.4
	Hypotony and hemorrhage	8	57.1
	Total	14	100.0
Medications used for hemorrhage	Methergina	3	42.9
	Methergina and Pabal	3	42.9
	Methergina, Pabal and others	1	14.3
	Total	7	100.0
Transfusion of blood or blood products	Yes	3	1.0
	No	297	99.0

(n) number of participants, (%) percentage of participants.

The results discussed above provide the basis for the research hypotheses no. 3 and 4, assuming that the use of epidural analgesia is not related to the necessity for transfusion of blood or blood products, or the occurrence of complications in the third stage of labor.

Influence of Epidural Analgesia on the Course of Labor

A statistically significant relationship was found between the duration of the first stage of labor and parity ($p = 0.038$); the value of Cramer's V coefficient (V = 0.160; $p = 0.041$) indicated that

the strength of this relationship was weak. The first stage of labor in primiparas lasted usually from six to nine hours (n = 94; 46.8%), while in multiparas less than five hours (n = 27; 57.4%). There was a statistically significant relationship between the duration of the second stage of labor and parity ($p < 0.001$); the value of Cramer's V coefficient indicated that the strength of this relationship was strong (V = 0.513; $p < 0.001$). In the case of primiparas, the second stage of labor lasted: from 31 to 60 minutes in 69 women (36.7%), from 61 to 90 minutes in 56 women (29.8%), or less than 30 minutes, whereas in multiparas it usually lasted less than 30 minutes (Table IV).

Analysis revealed that the majority of the women tolerated pain well after analgesia. Those of them who were able to control themselves before analgesia coped best (n = 104; 80.6%), while women who tolerated pain well (n = 13; 68.4%) and those who were excited (n = 79; 65.8%) before analgesia coped slightly worse ($p = 0.052$) (Table V).

These results support the research hypothesis no. 1, assuming that epidural analgesia alleviates labor pain. The described-above differences in pain tolerance may be due to individual predispositions, such as the pain threshold and mental preparation for labor.

No statistically significant relationships were found between the moment of administration of epidural analgesia, as guided by internal obstetric examination (cervical dilation), and the duration of either the first or second stage of labor ($p > 0.5$) (Table VI).

A statistically significant relationship was found between the fetal station and the duration of the first stage of labor ($p = 0.028$); the value of Cramer's V coefficient indicated that the strength of these relationships was weak (Cramer's V = 0.143; $p = 0.057$). In women whose babies were at the -4 to -3 station, the first stage of labor usually lasted from six to nine hours (n = 98; 47.6%), less often under five hours (n = 82; 39.8%). In women whose babies were at the -2 to -1 station, the first stage usually lasted less than five hours (n = 12; 66.7%), whereas in women whose babies were at the 0 station, the first stage lasted less than five hours (n = 1; 50.0%) or 10 to 15 hours (n = 1; 50.0%). No statistically significant relationship was found between the moment of administration of epidural analgesia (fetal station) guided by internal obstetric examination and the duration of the second stage of labor ($p > 0.5$) (Table VII).

Table IV. Analysis of the relationship between the duration of the 1st and 2nd stages and parity.

			1st stage			Total
			≤ 5 hours	6-9 hours	10-15 hours	
Parity	Primipara	n	77	94	30	201
		%	38.3%	46.8%	14.9%	100.0%
	Multipara	n	27	17	3	47
		%	57.4%	36.2%	6.4%	100.0%
Total		n	104	111	33	248
		%	41.9%	44.8%	13.3%	100.0%
Likelihood ratio χ^2 - = 6.55; df = V2; $p = 0.038$; V = 0.160; $p = 0.041$						

			2nd stage					Total
			≤ 30 minutes	31-60 minutes	61-90 minutes	91-120 minutes	> 120 minutes	
Parity	Primipara	n	42	69	56	19	2	188
		%	22.3%	36.7%	29.8%	10.1%	1.1%	100.0%
	Multipara	n	39	9	0	0	0	48
		%	81.3%	18.8%	0.0%	0.0%	0.0%	100.0%
Total	n	81	78	56	19	2	236	
		%	34.3%	33.1%	23.7%	8.1%	0.8%	100.0%
Likelihood ratio $\chi^2 = 70.42$; df = 4; $p < 0.001$; V = 0.513; $p < 0.001$								

(N) number of participants, (%) percentage of participants, *(χ^2)* Pearson's Chi-square independence test, (df) degrees of freedom, (V) Cramer's V contingency coefficient, *(p)* testing probability.

Table V. Relationship between pain complaints before and after epidural analgesia.

			Pain after analgesia			Total
			Tolerates well	Controls herself	Excited	
Pain sensation before the use of epidural analgesia	Tolerates well	n	13	6	0	19
		%	68.4%	31.6%	0.0%	100.0%
	Controls herself	n	104	24	1	129
		%	80.6%	18.6%	0.8%	100.0%
	Excited	n	79	41	0	120
		%	65.8%	34.2%	0.0%	100.0%
	Total	n	196	71	1	268
		%	73.1%	26.5%	0.4%	100.0%
Likelihood ratio $\chi^2 = 9.38$; df = 4; $p = 0.052$						

(n) number of participants, (%) percentage of participants, (χ^2) Pearson's Chi-square independence test, (df) degrees of freedom, *(p)* testing probability.

Table VI. Relationship between the moment of administration of epidural analgesia (cervical dilation based on internal obstetric examination) and the duration of the first and the second stages of labor.

			1st stage			Total
			≤ 5 hours	6-9 hours	10-15 hours	
Internal obstetric examination-cervical dilation	< 4 cm	n	30	39	7	76
		%	39.5%	51.3%	9.2%	100.0%
	4-5 cm	n	53	51	15	119
		%	44.5%	42.9%	12.6%	100.0%
	> 5 cm	n	11	14	5	30
		%	36.7%	46.7%	16.7%	100.0%
	Total	n	94	104	27	225
		%	41.8%	46.2%	12.0%	100.0%
Likelihood ratio $\chi^2 = 2.28$; df = 4; $p = 0.685$						

			2nd stage					Total
			≤ 30 minutes	31-60 minutes	61-90 minutes	91-120 minutes	> 120 minutes	
Internal obstetric examination-cervical dilation	< 4 cm	n	25	22	20	7	0	74
		%	33.8%	29.7%	27.0%	9.5%	0.0%	100.0%
	4-5 cm	n	37	39	24	9	1	110
		%	33.6%	35.5%	21.8%	8.2%	0.9%	100.0%
	> 5 cm	n	9	8	9	3	1	30
		%	30.0%	26.7%	30.0%	10.0%	3.3%	100.0%
Total		n	71	69	53	19	2	214
		%	33.2%	32.2%	24.8%	8.9%	0.9%	100.0%
Likelihood ratio $\chi^2 = 4.39$; df = 8; $p = 0.821$								

(n) number of participants, (%) percentage of participants, *(χ^2)* Pearson's Chi-square independence test, (df) degrees of freedom, *(p)* testing probability.

Table VII. Relationship between the moment of administration of epidural analgesia (the fetal station) based on internal obstetric examination and the duration of the first and the second stage of labor.

			1st stage			Total
			≤ 5 hours	6-9 hours	10-15 hours	
Internal obstetric examination- the fetal station	(-4) - (-3)	n	82	98	26	206
		%	39.8%	47.6%	12.6%	100.0%
	(-2) - (-1)	n	12	6	0	18
		%	66.7%	33.3%	0.0%	100.0%
	(0)	n	1	0	1	2
		%	50.0%	0.0%	50.0%	100.0%
Total		n	95	104	27	226
		%	42.0%	46.0%	11.9%	100.0%
Likelihood ratio $\chi^2 = 10.84$; df = 4; $p = 0.028$; V = 0.143; $p = 0.057$						

			2nd stage					Total
			≤ 30 minutes	31-60 minutes	61-90 minutes	91-120 minutes	> 120 minutes	
Internal obstetric examination- the fetal station	(-4) - (-3)	n	68	62	45	19	2	196
		%	34.7%	31.6%	23.0%	9.7%	1.0%	100.0%
	(-2) - (-1)	n	4	7	6	0	0	17
		%	23.5%	41.2%	35.3%	0.0%	0.0%	100.0%
	(0)	n	0	0	2	0	0	2
		%	0.0%	0.0%	100.0%	0.0%	0.0%	100.0%
Total		n	72	69	53	19	2	215
		%	33.5%	32.1%	24.7%	8.8%	0.9%	100.0%
Likelihood ratio $\chi^2 = 11.08$; df = 8; $p = 0.197$								

(n) number of participants, (%) percentage of participants, *(χ^2)* Pearson's Chi-square independence test, (df) degrees of freedom, (V) Cramer's V contingency coefficient, *(p)* testing probability.

Table VIII. Relationship between the year of delivery and pain complaints after the use of epidural analgesia.

			Pain complaints after the use of epidural analgesia			Total
			Tolerates well	Controls herself	Excited	
Year	2015	n	11	4	0	15
		%	73.3%	26.7%	0.0%	100.0%
	2016	n	8	7	0	15
		%	53.3%	46.7%	0.0%	100.0%
	2017	n	105	39	0	144
		%	72.9%	27.1%	0.0%	100.0%
	2018	n	60	15	1	76
		%	78.9%	19.7%	1.3%	100.0%
	2019	n	13	7	0	20
		%	65.0%	35.0%	0.0%	100.0%
Total		n	197	72	1	270
		%	73.0%	26.7%	0.4%	100.0%
Likelihood ratio $\chi^2 = 7.78$; df = 8; $p = 0.456$						

(n) number of participants, (%) percentage of participants, *(χ^2)* Pearson's Chi-square independence test, (df) degrees of freedom, *(p)* testing probability.

These results allow us to partially accept hypothesis no. 2, which indicates that the moment of administration of epidural analgesia (cervical dilation, fetal station), guided by internal obstetric examination, affects the duration of the first and the second stages of labor. In fact, no relationship was found between the moment of administration of epidural analgesia based on cervical dilation and the duration of the first or the second stage of labor.

Our study revealed a link between the moment of administration of epidural analgesia based on fetal station and the duration of the first stage of labor: the farther down the baby's head descended into the pelvis, the shorter the first stage of labor was.

The Impact of Epidural Analgesia on the Course of Labor in 2015-2019

Cross-table analysis did not demonstrate a statistically significant relationship between the year of delivery and pain sensation after the use of analgesia ($p > 0.05$) (Table VIII).

Cross-table analysis performed using the likelihood-ratio test revealed no statistically significant relationship between the year of delivery and the duration of the first stage of labor ($p > 0.05$) (Table IX).

Cross-table analysis demonstrated a statistically significant relationship between the year of delivery and the duration of the second stage of labor ($p = 0.023$). In the case of women who gave birth in 2015, the second stage usually lasted less than 30 minutes (n = 9; 64.3%), less frequently from 31 to 60 minutes (n = 4; 28.6%). In 2016, the second stage usually lasted less than 30 minutes (n = 11; 39.3%), less frequently from 31 to 60 minutes (n = 10; 33.3%) and from 61 to 90 minutes (n = 6; 21.4%). In 2017, the second stage usually lasted from 31 to 60 minutes (n = 41; 33.3%), less frequently under 30 minutes (n = 37; 30.1%) and from 61 to 90 minutes (n = 34; 27.6%). In 2018, the second stage usually lasted under 30 minutes (n = 20; 36.4%), less frequently from 61 to 90 minutes (n = 16; 29.1%) and from 31 to 60 minutes (n = 15; 27.3%). In 2019, the second stage usually lasted from 31 to 60 minutes (n = 8; 50.0%), less frequently under 30 minutes (n = 4; 25.0%) and from 61 to 90 minutes (n = 4; 25.0%) ($p = 0.087$) (Table X).

Our five-year analysis demonstrated a significant adverse change in the length of the second stage of labor. For the interval of ≤ 30 minutes, the percentage of parturients decreased more than 2.5 times compared to 2015. For the interval of 31-60 minutes, the percentage of parturients in 2019 increased more than 1.7 times compared to 2018 and 2015, and 1.5 times compared to 2017 and 2016. In 2019, there were no parturients for whom the second stage of labor lasted between 61-90 minutes, but the percentage of parturients for whom it lasted 91-120 minutes increased 3.5 times compared to previous years (Figure 1).

Table IX. Relationship between the year of delivery and the duration of the first stage of labor after the use of epidural analgesia.

			1st stage			Total
			≤ 5 hours	6-9 hours	10-15 hours	
Year	2015	n	6	4	3	13
		%	46.2%	30.8%	23.1%	100.0%
	2016	n	10	13	6	29
		%	34.5%	44.8%	20.7%	100.0%
	2017	n	58	52	16	126
		%	46.0%	41.3%	12.7%	100.0%
	2018	n	24	32	7	63
		%	38.1%	50.8%	11.1%	100.0%
	2019	n	6	10	1	17
		%	35.3%	58.8%	5.9%	100.0%
Total		n	104	111	33	248
		%	41.9%	44.8%	13.3%	100.0%

Likelihood ratio $\chi^2 = 6.48$; df = 8; $p = 0.594$

(n) number of participants, (%) percentage of participants, *(χ^2)* Pearson's Chi-square independence test, (df) degrees of freedom, *(p)* testing probability.

Table X. Relationship between the year of delivery and the duration of the second stage of labor after the use of epidural analgesia.

			2nd stage					Total
			≤ 30 minutes	31-60 minutes	61-90 minutes	91-120 minutes	> 120 minutes	
Year	2015	n	9	4	0	1	0	14
		%	64.3%	28.6%	0.0%	7.1%	0.0%	100.0%
	2016	n	11	10	6	1	0	28
		%	39.3%	35.7%	21.4%	3.6%	0.0%	100.0%
	2017	n	37	41	34	9	2	123
		%	30.1%	33.3%	27.6%	7.3%	1.6%	100.0%
	2018	n	20	15	16	4	0	55
		%	36.4%	27.3%	29.1%	7.3%	0.0%	100.0%
	2019	n	4	8	0	4	0	16
		%	25.0%	50.0%	0.0%	25.0%	0.0%	100.0%
Total		n	81	78	56	19	2	236
		%	34.3%	33.1%	23.7%	8.1%	0.8%	100.0%

Likelihood ratio $\chi^2 = 29.18$; df = 16; $p = 0.023$; V = 0.160; $p = 0.087$

(n) number of participants, (%) percentage of participants, *(χ^2)* Pearson's Chi-square independence test, (df) degrees of freedom, (V) Cramer's V contingency coefficient, *(p)* testing probability.

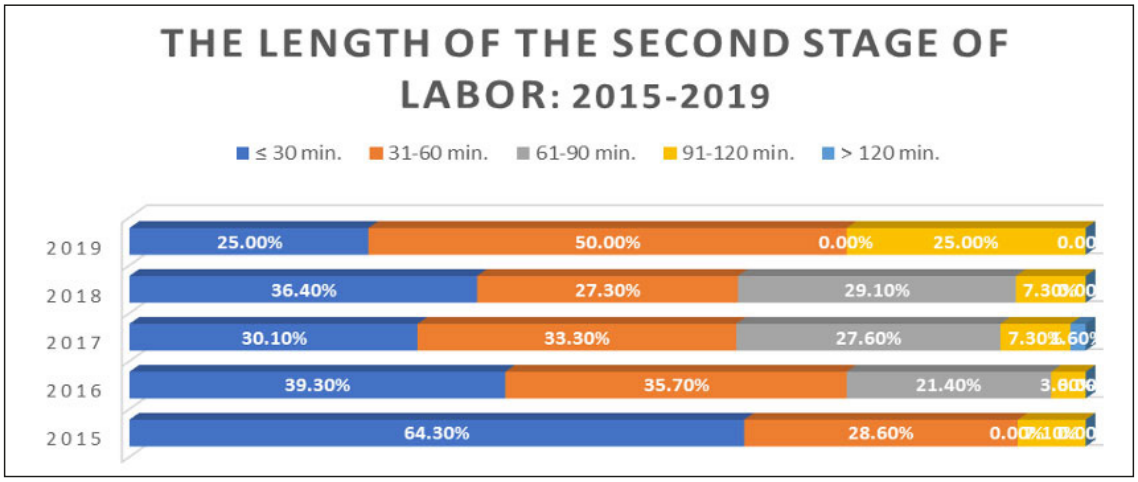

Figure 1. Duration of the second stage of labor after the use of epidural analgesia in 2015-2019.

Discussion

Natural childbirth involves a wide range of pain complaints, whose nature, location, and intensity depend on the stage of labor. In the first stage, labor pain is caused by regular uterine contractions and dilation of the uterine body and cervix. The pain is acute and visceral, involving the lower and mid abdomen. In the second stage, pain is caused by stretching of the pelvic floor muscles, the pressure of the roots of the lumbar and sacral plexus, and fetal pressure on the vagina and pelvic structures. In the third stage of labor (when the placenta is born), pain decreases and is not too severe[18,19,26-28]. The gold standard and the most effective method of pharmacological labor pain relief is continuous lumbar epidural analgesia. This is performed not only for medical indications but also at the patient's request, unless there are medical contraindications. In 2012, the

Polish Society of Anesthesiology and Intensive Therapy published guidelines on labor epidural analgesia, including information on indications, contraindications, and side effects. According to these guidelines, regional labor analgesia may be administered once the parturient has been provided with the above information and has given her informed written consent[1-4,24,29-31].

In 2003, Dickinson et al[32] analyzed 992 primiparas randomly assigned either to a group receiving epidural analgesia or to a group receiving midwife support (pethidine, nitrous oxide etc.). They found that the median of pain in both groups before the intervention was 85 (on a scale from 0 to 100, with 100 defined as unimaginable pain). In the women who gave birth under analgesia, the median decreased to 27, while in the midwife support group the median decreased only to 75. Another meta-analysis[33] investigated 2,703 nulliparas who were given epidurals or intravenous opioids to relieve labor pain. The women rated the degree of pain on the Visual Analogue Scale (VAS) from 0 to 10 (with 10 denoting the highest severity). Before the intervention, the mean score was nine. One group of parturients then received epidural analgesia, and the degree of pain reported decreased to two; the other group was given intravenous pethidine and the degree of pain reduced to four. In our study, epidural analgesia reduced labor pain. After administration of epidurals, the majority of women tolerated pain well (68.4%); however, those who were able to control the pain before the administration of analgesia felt best (80.6%) ($p = 0.052$). This may suggest that there can be individual predispositions associated with pain threshold and mental preparation for labor.

Labor is divided into four stages. During the first stage, the cervix dilates by up to 10 cm and uterine contractile activity increases. This stage lasts about 9-15 hours for primiparas and about 7-9 hours for multiparas. The second stage is the period from full cervical dilation to the birth of the baby. This should last no more than two hours, or up to three hours with epidural analgesia. The third stage of labor – also called the placental or afterbirth stage – starts immediately after the birth of the baby and ends with the expulsion of the placenta; this takes about 5-30 minutes. The fourth stage of labor is recovery, which begins with delivery of the placenta and lasts for one to two hours.

The results of Anim-Somuah et al[30] and Rimaitis et al[34] indicate that analgesia may shorten or prolong the first stage of labor. Weigl et al[35] analyzed two groups of women over a period of twelve months: the first group consisted of 191 women who received labor epidural analgesia, and the second group contained 209 women who delivered without this. These authors indicate that the first stage of labor in the group receiving analgesia was longer than usual ($p < 0.01$). The extension of the first stage of labor may result from the initial difference in the speed of labor, depending on individual differences between women. Cervical dilation after receiving epidural analgesia was analyzed, and an increase in the speed of cervical dilation after administration of local anesthetics was seen. We have hence formulated the hypothesis that epidural analgesia accelerates cervical dilation.

Many studies[2,3,24,30,36-38] have shown a relationship between the use of epidurals and the extension of the second stage of labor. Zhang et al[39] studied 1,088 women in the United States, where the rate of using epidural analgesia for labor increased from 1% to 84%, and the length of the second stage of labor increased by about 25 minutes over a year ($p < 0.01$). According to Liu et al[2], epidural analgesia prolonged the second stage of labor by 15 to 30 minutes. In their multicenter trial, Halpern et al[40] noticed that the duration of the second stage of labor in the epidural analgesia group increased by a median of 23 minutes ($p = 0.02$), while Sharma et al[33] reported a 40-to-90-minute extension.

Liu et al[2], Anim-Somuah et al[30], and Mc Grady and Litchfield[41] have estimated that epidural analgesia prolongs the first stage of labor by 42 minutes, and the second stage of labor by approximately 13-14 minutes. It is noteworthy, however, that the use of low doses of LAs (bupivacaine < 0.125% or ropivacaine < 0.2%) together with opioids markedly reduced the differences in the length of the first stage of labor, and can completely eliminate the effects of analgesia on the duration of the second stage of labor[2,41]. According to the ACOG guidelines, the normal duration of the second stage under epidural analgesia is two hours for multiparas, and three hours for primiparas[42].

In our study, the choice of the moment of administration of epidural analgesia (cervical dilation), guided by internal obstetric examination, was not associated with the duration of the first stage of labor ($p = 0.685$). However, it is worth noting that, in a situation where more than 80% of parturients were primiparas, the first stage of labor lasted no longer than nine hours in almost 90% of cases; the statistical duration of this stage for primiparas is 9-15 hours. The moment of ad-

ministration of epidural analgesia, chosen on the basis of cervical dilation, had no effect on the second stage of labor ($p > 0.5$). Giving an epidural on the basis of fetal station was related to the duration of the first stage of labor ($p = 0.028$): the farther down the fetal head descended into the pelvis, the shorter the first stage of labor was. What is more, we observed the same tendency for the fetal station as for cervical dilation: the first stage of labor lasted no longer than nine hours in almost 90% of women, with a statistical duration of 9-15 hours for fetal stations of -4 or -3.

Our study did not find analgesia to have any effect on the course and complications of the third stage of labor, or any relationship between the use of epidural analgesia and the need for blood or blood product transfusions. Similar findings regarding complications in the third stage and approximate perinatal blood loss were reported by Weigl et al[35]. We analyzed how the year of delivery was related to the duration of the third stage of labor and the amount of blood lost, but did not note significant differences for any of these variables ($p > 0.05$).

Epidural analgesia is the most effective method of relieving labor pain. Unfortunately, it may also disturb the natural rhythm of labor, shortening its first stage, extending its second stage, or both. The use of epidural analgesia should therefore be preceded by a documented assessment of the intensity of pain, and the patient's informed consent should be given.

Limitations

The limitation of the study is that it does not provide data on how the epidural anesthesia was performed, which local anesthetic was used, what the volume and concentration of local anesthetic was. This is due to the fact that our purpose was to analyze strictly obstetrical and not anesthesiological aspects. Nevertheless, these mentioned-above more specific issues are worth taking into account, and could be the focus of further research.

Conclusions

The use of epidural analgesia during labor may disturb its natural rhythm, shortening the first stage, extending the second stage, or both. This happens even if the choice of the moment for using analgesia is guided by obstetric indications, and may result in the necessity for medical intervention, such as cesarean section.

Pain management is an integral part of appropriate obstetric care. Severe pain is a powerful stress factor, and labor pain is one of the worst pain experiences. Epidural analgesia reduces labor pain, but cannot eliminate it completely, on account of individual predispositions and circumstances.

Despite advances in labor epidural analgesia, this method is still controversial, and studies so far have failed to provide a definitive explanation of how it impacts the course of labor. Nevertheless, it should be remembered that epidural analgesia is a medical intervention, and using pharmacology for physiological labor may not be indifferent to the mother and the baby.

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Dorota Branecka-Woźniak: conceptualization, data collection, formal analysis, writing-original draft preparation, writing–review and editing. Anna Józefowicz: data collection, formal analysis, writing oforiginal draft preparation. Aneta Cymbaluk-Płoska: statistical analysis, supervision and project administration. Rafał Kurzawa: statistical analysis, supervision and project administration.

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Conflict of Interest
The authors declare no conflict of interest.

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