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P R A C E O R Y G I N A L N E
położnictwo

Hemodynamic parameters following bilateral internal iliac arteries ligation as a treatment of intrapartum hemorrhage

Parametry hemodynamiczne po obustronnym podwiązaniu tętnic biodrowych wewnętrznych, w leczeniu krwotoku porodowego

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Abstract

Objective: *The internal iliac arteries ligation (IIAL) is a particularly effective method, maintaining fertility, of dealing with intrapartum hemorrhage.*

Aim: *Hemodynamic evaluation of the ovarian arteries(OA) and uterine arteries (UA) in patients after IIAL.*

Material: Study Group consisted of 6 women who underwent IIAL to treat intrapartum hemorrhage – without hysterectomy. Control Group consisted of 6 women, at the same age group, parity and time after delivery, who did not undergo IIAL.

Method: *Perfusion characteristics were studied by means of a transvaginal Doppler system. Resistance index (RI), pulsatility index (PI) and systolic/diastolic ratio(S/D) were measured in the uterine and ovarian arteries. Nonparametric comparison of the two groups was performed with the help of Two-sample Wilcoxon rank-sum (Mann-Whitney) test.*

Results:

1. Change of perfusion in OA- PI: 1.40 vs. 3.76 Prob <0.05; RI: 0.86 vs. 0.91 Prob >0.05; S/D: 3.25 vs. 18.2 Prob <0.05.

2. Change of perfusion in UA- PI: 2.20 vs. 2,75 Prob >0,05; RI 0.82 vs. 0.86 Prob >0.05; S/D: 5.28 vs. 7.81 Prob >0.05.

Conclusions:

1. IIAL as a way of treating intrapartum haemorrhage, causes the decrease of pulsatility index(PI) and systolic/diastolic ratio (S/D) in ovarian arteries.

2. Characteristic changes of PI, RI and S/D parameters in uterine arteries after IIAL have not been observed.

3. Changes of ovarian flow velocity parameters suggest the possibility of changes in the ovarian function.

Key words: **internal iliac artery** / **ligation** / **postpartum hemorrhage** / / **blood flow velocity** /

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Streszczenie

Wstęp: *Podwiązanie tętnic biodrowych wewnętrznych (IIAL) jest skuteczną metodą leczenia ciężkich krwotoków porodowych, zachowującą płodność kobiety.*

Cel: *Ocena parametrów hemodynamicznych w tętnicach jajnikowych (OA) oraz macicznych (UA) u kobiet po IIAL.*

Materiał: *Grupa badana: 6 kobiet po IIAL jako metodzie leczenia krwotoku porodowego z pozostawieniem macicy. Grupa kontrolna: 6 kobiet w tym samym wieku, rodności i czasie po porodzie, u których niewykonano IIAL.*

Metoda: *Parametry przepływów w naczyniach mierzono ultrasonograficznie głowicą dopochwową z systemem Dopplera.*

Oznaczono index oporu (RI), index pulsacji (PI), oraz współczynnik skurczowo-rozkurczowy (S/D) w tętnicach macicznych oraz jajnikowych. Nieparametryczne porównanie obu grup przeprowadzono za pomocą testu Wilcoxona.

Wyniki:

1. Zmiany przepływów w tętnicach jajnikowych- PI: 1,40 vs 3,76 Prob <0,05; RI: 0,86 vs 0,91 Prob >0,05; S/D: 3,25 vs 18,2 Prob <0,05.

2. Zmiany przepływów w tętnicach macicznych- PI: 2,20 vs 2,75 Prob >0,05; RI 0,82 vs 0,86 Prob >0,05; S/D: 5,28 vs 7,81 Prob >0,05.

Wnioski:

1. IIAL jako metoda leczenia krwotoku porodowego powoduje obniżenie wartości współczynników PI oraz S/D w tętnicach jajnikowych.

2. Nie stwierdzono charakterystycznych zmian wartości współczynników PI, RI oraz S/D w tętnicach macicznych.

3. Zmiany parametrów przepływu krwi w tętnicach jajnikowych sugerują możliwość wystąpienia zmian czynnościowych jajników u kobiet po IIAL.

Słowa kluczowe: **tętnica biodrowa wewnętrzna** / **podwiązanie** / **krwotok poporodowy** / / **przepływy naczyniowe** /

Background

A hemodynamically unstable patient with an intrapartum hemorrhage presents a therapeutic challenge. One of the most successful ways of treatment that prevents hysterectomy is internal iliac arteries ligation (IIAL) [1, 2, 3].

Anatomically, there is a lot of vascular anastomoses located in the true pelvic, which theoretically, might protect tissue from ischemia after the IIAL procedure [4, 5, 6].

Interesting questions may be posed: is the efficiency of these anastomoses the same in each patient after the IIAL? What outcomes of the IIAL might be expected in case of young women if the collateral circulation was not efficient enough to supplement tissue requirement? Distant effects of changes of the blood flow parameters in true pelvic vessels remain unknown. The deficiency of the blood perfusion in ovarian branches of the uterine artery observed after uterine artery embolization has a harmful effect on the ovarian hormonal activity [7].

Furthermore, neurological and orthopaedic complications may occur as well [8, 9]. The key to the proper evaluation of the problem is the analysis of the anatomy of the internal iliac artery and its anastomoses.

The anastomoses of the internal iliac artery [10]

1. The aorta-through communications between:

a) the uterine artery – the ovarian artery
b) the iliolumbar artery – arteries lumbales inferiors
c) the middle rectal artery – the superior rectal artery (the branch of the mesenteric artery)
d) the lateral sacral artery – the median sacral artery

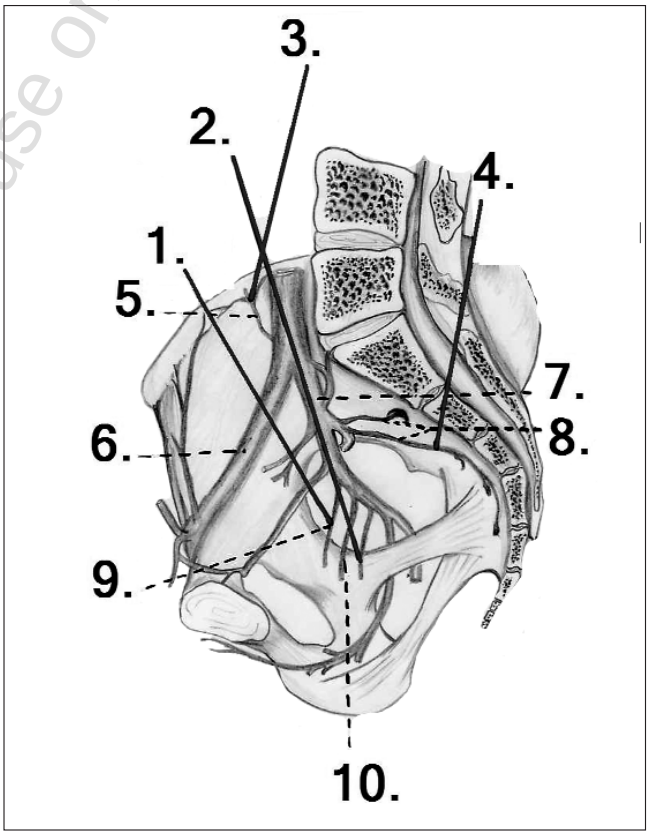

Figure 1. The aorta-through communications.
1 – ovarian a. 2 – superior rectal a. 3 – aa lumbales inferiors
4 – the median sacral a. 5 – iliolumbar a. 6 – external iliac a.
7 – internal iliac a. 8 – lateral sacral a. 9 – uterine a.
10 – middle rectal a.

2. The external iliac artery-through communications between:

a) the obturator artery – the inferior epigastric artery ("corona mortis")

b) the iliolumbar artery – the deep circumflex iliac artery

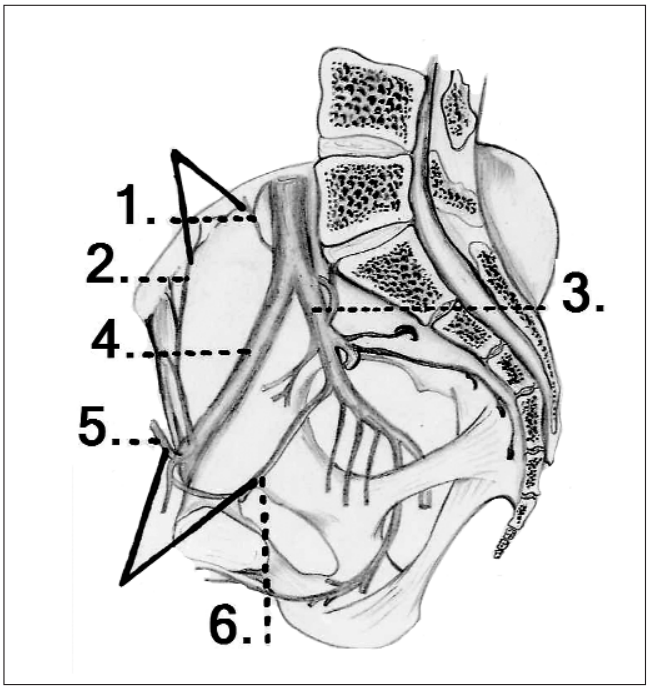

Figure 2. The external iliac artery-through communications.
1 – iliolumbar a. 2 – circumflex iliac a. 3 – internal liac a.
4 – external iliac a. 5 – inferior epigastric a. 6 – obturator a.

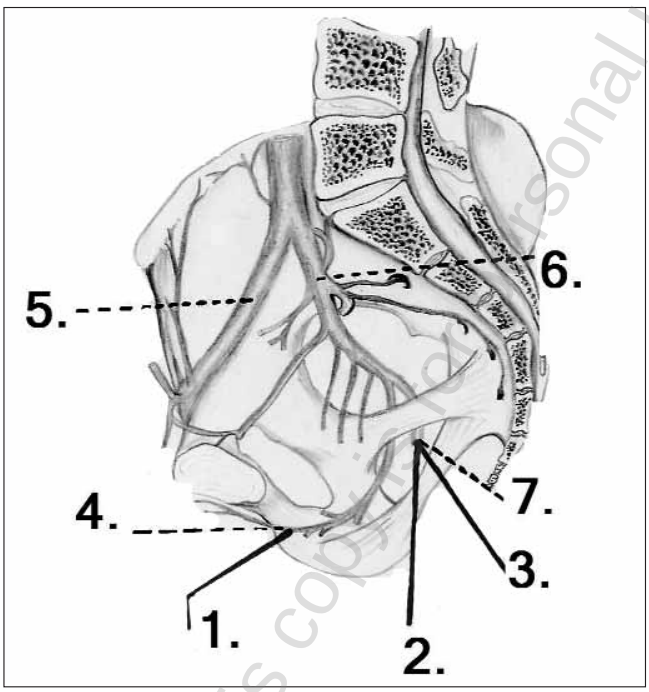

Figure 3. The femoral artery-through communications.
1 – external pudendal a. 2 – superior perforating a.
3 – medial circumflex a. 4 – internal pudendal a.
5 – external iliac a. 6 – internal iliac a.

3. The femoral artery-through communications between:

a) the inferior gluteal artery – the superior perforating artery (the branch of the deep femoral artery)

b) the inferior gluteal artery – the medial circumflex artery of the thigh

c) the internal pudendal artery – external pudendal arteries.

Aim

Hemodynamic evaluation of the uterine and ovarian arteries by means of a high-frequency transvaginal image-directed Doppler system in patients with bilateral internal iliac arteries ligation as a way of treating intraparum haemorrhage.

Material

Study Group consisted of 6 women who underwent bilateral IIAL to treat intrapartum hemorrhage – without hysterectomy.

Table I. Patient's clinical characteristics.

Patent number	Age	Parity	Time after IIAL (years)
1	21	Parturision - 1 miscarriage - 0	1
2	24	Parturision - 1 miscarriage - 1	3
3	22	Parturision - 4 miscarriage - 0	1
4	31	Parturision - 2 miscarriage - 0	1
5	26	Parturision - 2 miscarriage - 1	2
6	34	Parturision - 1 miscarriage - 2	4

Since IIAL procedure, one of these women (nr 2) suffer from Pelvic Pain Syndrome, and she sustains another miscarriage 18 months later. There were no any pregnancies in the rest of the group after the treatment (lack of desire).

The Control Group consisted of Study Group's age, parity and time after delivery counterparts, who did not undergo the IIAL procedure.

Method

Perfusion characteristics of the uterine and ovarian arteries were studied by means of a high-frequency transvaginal image-directed Doppler system. A 7-MHz Doppler transducer was equipped with a probe designed for intravaginal use. Resistance index (RI), pulsatility index (PI) and systolic/diastolic ratio(S/D) were measured.

Flow velocity profiles in the ovarian artery were sampled from the infundibulo-pelvic ligament. Nonparametric comparison of the two groups was performed with the help of Two-sample Wilcoxon rank-sum (Mann-Whitney) test.

Results

Table II. Perfusion in ovarian artery.

Patient number	STUDY GROUP			CONTROL GROUP		
	PI	RI	S/D	PI	RI	S/D
1	1.24	0.78	3.2	2.00	0.80	5.4
2	1.83	0.98	3.3	4.86	0.97	68.0
3	1.12	0.89	3.2	3.92	0.87	7.7
4	2.12	0.98	4.2	4.12	0.96	12.1
5	1.43	0.79	3.0	3.66	0.87	5.8
6	0.68	0.74	2.6	4.01	0.99	10.6

PI parameter: 1,40 *vs.* 3,76
Prob > |z| <0,05
RI parameter: 0,86 *vs.* 0,91
Prob > |z| >0,05
S/D parameter: 3,25 *vs.* 18,2
Prob > |z| <0,05

Table III. Perfusion in the uterine artery.

Patient number	STUDY GROUP			CONTROL GROUP		
	PI	RI	S/D	PI	RI	S/D
1	2.38	0.93	11.2	2.93	0.90	10.0
2	2.79	0.70	4.3	2.89	0.91	13.5
3	2.78	0.87	5.9	3.21	0.88	9.6
4	3.2	0.94	4.8	2.97	0.87	5.7
5	0.87	0.57	2.2	1.78	0.73	4.3
6	1.22	0.90	3.3	2.73	0.87	3.8

PI parameter: 2,20 *vs.* 2,75
Prob > |z| >0,05
RI parameter: 0,82 *vs.* 0,86
Prob > |z| >0,05
S/D parameter: 5,28 *vs.* 7,81
Prob > |z| >0,05

Discussion

One of the major signs of IIAL is a change in pelvic vascular flow. There are documented cases of uncomplicated courses of pregnancies after previous ligation of both internal iliac arteries [11]. The first one was published in 1976 by Esperanza et al [12]. However, there are also abbreviations which describe the rate of infertilities, abortions and IUGR after intrapartum hemorrhage and IIAL [13].

Knowledge about late onset outcomes of IIAL concerning urinary bladder function, pelvic organs atrophy and degeneration of the acetabular bone remains insufficient.

The blood flow disorders, resulting from IIAL, in the area of superior gluteal arteries might be the fundamental reason of degeneration of the fornix of the acetabulum [8]. Degeneration or the absence of the acetabular artery is observed in most patients with congenital luxation of the hip joint.

Due to Atala et al. there were neither complications in the procedure nor ischemia, several years after the IIAL procedure, in 25 cases from the study group [14]. In 2007 Hehenkamp et al. revealed in a randomized comparison the loss of ovarian reserve after uterine artery obliteration [7].
In conclusion, the IIAL is certainly a useful alternative to extreme solutions in certain cases of severe or persistent hemorrhage, but there is no evidence based improvement of life quality after IIAL.

In an experimental hemodynamic study of the pelvic collateral circulation, Takebe et al. demonstrated that when the unilateral iliac artery was occluded, the blood flow making a "stopover" within the pelvis was found to be significantly less than that of the anatomical hemodynamics, even under a resting condition. The blood flow decreased more significantly under exercise loading than under a resting condition, which demonstrates the presence of the "steal" phenomenon. If the pelvic region is in the state of ischemia, owing to the "steal" phenomenon, reconstruction of the blood vessels flowing into the pelvis is not required [6].

These observations are consistent with Bochenek's studies [10] based on the blood vessels anatomy, who found that there is a possibility of unilateral IIAL without severe clinical effects. Is the bilateral IIAL equally safe? The materials are not univocal, especially when a late onset of multiorgans effects is concerned.

The important problem after IIAL is its influence on nervous system function. In 2001 Shin et al. reported peripheral nerve ischaemia after IIAL [11]. Another problem is the risk of ureteral fistula as a complication of changes in blood supply, especially if the ligation is higher than 2 cm below common iliac artery bifurcation. At this level, internal iliac artery sends the nutritious branch to the ureter [10].

Owing to the completed study, changes of the blood flow in ovarian arteries in women after IIAL were found to be of importance. A decrease of pulsatility index (PI) and systolic/diastolic ratio (S/D) in ovarian arteries was observed . The probable reason of these findings may be a compensative increase of the blood flow from the ovarian artery to connection with ascending branch of the uterine artery.

No characteristic hemodynamic changes in uterine arteries in the examined group have been observed. A possible explanation for that might be the number of physiological variabilities of the blood flow in uterine arteries, what was first discovered by Thaler et al. in hemodynamic evaluation of the female pelvic vessels[4], and later confirmed by Chitrit[15].

The number of variability of parameters of the blood flow in the true pelvic vessels in women after the IIAL, arises probably from individually variable possibilities of collateral circulation. The individual variability of haemodynamic efficiency of anastomoses of the internal iliac arteries probably determines the divergence of the late onset clinical results of IIAL.

Conclusions

1. The internal iliac artery ligation to treat intrapartum haemorrhage causes the decrease of pulsatility index (PI) and systolic/diastolic ratio (S/D) in ovarian arteries.
2. Characteristic changes of PI and RI parameters in the uterine arteries after the ligation of the internal iliac artery have not been observed.
3. Changes of the ovarian flow velocity parameters suggest the possibility of changes in the ovarian function in the observed patients.

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