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Factors associated with uterine atony

Factores asociados a atonía uterina

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ABSTRACT

Postpartum hemorrhage (PPH) is the most important pathology in terms of maternal mortality, being one of the main public health concerns. Uterine atony is the main cause of PPH. **Objective:** To determine the factors associated with the development of uterine atony. **Methods:** Observational analytical case-control study of 4,148 immediate postpartum patients attended at the Obstetrics Department of the Hospital Regional Docente de Trujillo, Peru, between 2009 and 2019; 1,037 patients presented uterine atony and 3,111 were controls. **Results:** When performing the bivariate analysis, the variables that presented statistical significance as associated factors for the development of uterine atony were cesarean delivery [OR 1.98 (95% CI: 1.71-2.29)], being from the highlands [OR 1.38 (95% CI: 1.12-1.70)], multiple pregnancy [OR 4.48 (95% CI: 3.43-5.83)], dysfunctional delivery [OR 1.82 (95% CI: 1.44-2.31)] and macrosomic fetus [OR 1.37 (95% CI: 1.08-1.73)]. On the other hand, having been primiparous [OR 0.79 (95% CI: 0.65-0.94)] and being multiparous [OR 0.82 (95% CI: 0.69-0.97)] were shown as factors not associated with statistical significance. **Conclusions:** Factors associated with the development of uterine atony were cesarean section as the route of delivery, being from the highlands, and having had a macrosomic fetus, polyhydramnios and multiple pregnancies.

Key words: Uterine hemorrhage, Uterine inertia.

RESUMEN

La hemorragia postparto (HPP) es la patología de mayor trascendencia con respecto a mortalidad materna, siendo esta una de las principales preocupaciones de la salud pública. La atonía uterina es la principal causa de HPP. **Objetivo.** Determinar los factores asociados al desarrollo de atonía uterina. **Métodos.** Estudio observacional analítico de casos y controles de 4,148 pacientes puérperas inmediatas atendidas en el servicio de Obstetricia del Hospital Regional Docente de Trujillo, Perú, entre los años 2009 y 2019; 1,037 pacientes presentaron atonía uterina y 3,111 fueron los controles. **Resultados.** Al realizar el análisis bivariado, las variables que presentaron significancia estadística como factores asociados para el desarrollo de atonía uterina fueron el parto por cesárea [OR 1,98 (IC 95%: 1,71 a 2,29)], proceder de la sierra [OR 1,38 (IC 95%: 1,12 a 1,70)], el embarazo múltiple [OR 4,48 (IC 95%: 3,43 a 5,83)], parto disfuncional [OR 1,82 (IC 95%: 1,44 a 2,31)] y feto macrosómico [OR 1,37 (IC 95%: 1,08 a 1,73)]. Por otro lado, se mostraron como factores no asociados con significancia estadística el haber sido primípara [OR 0,79 (IC 95%: 0,65 a 0,94)] y el ser múltipara [OR 0,82 (IC 95%: 0,69 a 0,97)]. **Conclusiones.** Los factores asociados al desarrollo de atonía uterina fueron la cesárea como vía de culminación del parto, el ser procedente de la sierra, y haber tenido un feto macrosómico, polihidramnios y embarazos múltiples.

Palabras clave. Hemorragia uterina, Inercia uterina.

INTRODUCTION

Maternal mortality is one of the main public health concerns, with postpartum hemorrhage (PPH) being the most important pathology in this problem worldwide⁽¹⁾, with a high incidence in developing countries such as ours. The main cause of postpartum hemorrhage is uterine atony⁽²⁾.

Predicting the risk of PPH due to uterine atony would minimize its occurrence in the postpartum period⁽³⁾, through early intervention or adequate and timely referral to a care center that has the necessary tools to save the patient's life.

Uterine atony can occur in 1 in 20 deliveries⁽¹⁾, produces 80% of PPH cases and can cause up to 50% of maternal deaths in low-resource countries^(1,4). In Peru, in 2018, the National Center for Epidemiology, Prevention and Disease Control⁽⁵⁾ reported uterine atony as the second leading cause of direct maternal death at 19.6%.



Uterine atony is defined as the lack of ability of the uterus to contract and remain so during the immediate puerperium (24 hours), generating the lack of closure of the arteries⁽⁶⁾. In normal labor, the myometrial vessels have an immediate adaptive mechanism for physiological hemostasis, and thus act by contracting themselves, resulting in occlusion of placental bed arteries. In the absence of arterial closure, a flaccid uterus will be found in the physical evaluation, with the presence of bleeding of 500 mL after vaginal delivery or more than 1000 mL after cesarean section, in the first 24 hours of the puerperium. On palpation there will be little or no response to manual stimulation^(1,6).

In a hemorrhage due to uterine atony, about 500 to 600 mL of blood can be lost per minute^(3,7). Treatment depends on how compromised the patient's hemodynamic status is; it may be medical or surgical, up to hysterectomy⁽¹⁾.

There are several factors that predispose to the development of uterine atony, among them, muscle fiber depletion in a multiparous woman. In older women (over 35 years of age), sclerotic changes may make it more difficult for the vessels to close, thus facilitating bleeding^(8,9).

Among the factors that generate uterine atony are cesarean delivery, multiple gestations^(10,11), extreme ages of reproductive life^(10,12), eutocic delivery and nulliparity⁽¹⁰⁾.

In a Peruvian EsSalud hospital⁽¹³⁾, cesarean section was found to be a risk factor for uterine atony (OR 6.64) compared to vaginal delivery. In Trujillo, at the Hospital Regional Docente⁽¹⁴⁾, multiparity was found to be a high-risk factor.

This has motivated the present research project to determine the factors associated with uterine atony for proper management. Carrying out this project in the Obstetrics Service of the Hospital Regional Docente de Trujillo will allow us to have statistics of our environment.

METHODS

This is a retrospective analytical observational retrospective longitudinal case-control study. The sample size was obtained from a database of the Perinatal Informatics System (SIP, for its acronym in Spanish) of clinical histories of immediate postpartum women attended in the obstetrics service of the Hospital Regional Docente de Trujillo during the period 2009-2019.

Of a total of 39,722 patients, 31,615 met the inclusion and exclusion criteria, ending with 1,037 cases. The 3,111 controls were selected by simple random sampling until completing the sample size of 3 controls for each case. All immediate postpartum women who presented with uterine overdistension, including multiple pregnancy, polyhydramnios, macrosomic fetuses or dysfunctional labor were included. Immediate puerperal women with incomplete perinatal clinical history or with presumptive history and/or diagnosis of chorioamnionitis, uterine inversion, retained placental debris, hypertensive disorders of pregnancy, coagulation disorders or birth canal lesions were excluded.

The information obtained was recorded in a spreadsheet for statistical analysis and presentation in tables. The odds ratio and the chi-square statistical test were applied, and a multivariate analysis was performed with the significant factors using logistic regression.

RESULTS

As shown in Table 1, the variables that showed statistical significance as factors associated with the development of atony were cesarean delivery [OR 1.98 (95% CI: 1.71-2.29)] and proceeding from the highlands [OR 1.38 (95% CI: 1.12-1.70)]. On the other hand, the following factors were not associated with statistical significance: having been a primiparous mother [OR 0.79 (95% CI 0.65-0.94)] and being multiparous [OR 0.82 (95% CI 0.69-0.97)].

In the bivariate analysis (Table 2), the intervening variables that were statistically significant



TABLE 1. FACTORS ASSOCIATED WITH THE DEVELOPMENT OF UTERINE ATONY.

Factors		Hemorrhage from uterine atony				p	OR (95% CI)
		Yes		No			
		Frequency	%	Frequency	%		
Route of completion of labor delivery	Cesarean section	691	67%	1,562	50%	0.000	1.98 (1.71-2.29)
	Vaginal	346	33%	1,549	50%		ref.
Number of gestations	Nulliparous	408	39%	1,102	35%	0.001	ref.
	Primiparous	248	24%	849	27%		0.79 (0.65-0.94)
	Multiparous	306	30%	1,009	32%		0.82 (0.69-0.97)
	Large multiparous	75	7%	151	5%		1.34 (0.99-1.81)
Age	< 15	6	1%	26	1%	0.069	ref.
	15-35	876	84%	2,702	87%		1.40 (0.57-3.42)
	> 35	155	15%	383	12%		1.75 (0.71-4.34)
Marital status	Single	105	10%	395	13%	0.05	2.39 (0.29-19.09)
	Married	120	12%	395	13%		2.73 (0.34-21.79)
	Cohabitant	811	78%	2,312	74%		3.15 (0.40-24.96)
	Other	1	0%	9	0%		ref.
Educational level	Illiterate	17	2%	39	1%	0.012	ref.
	Elementary	202	19%	616	20%		0.75 (0.42-1.36)
	Secondary	660	64%	1,835	59%		0.83 (0.46-1.47)
	Non-university higher education	110	11%	432	14%		0.58 (0.32-1.07)
	Higher university	48	5%	189	6%		0.58 (0.30-1.11)
Origin	Highlands	143	14%	323	10%	0.003	1.38 (1.12-1.70)
	Coast	894	86%	2,788	90%		
Total		1,037	100%	3,111	100%		

Source: Hospital Regional Docente de Trujillo - Data collection forms 2009 - 2019.

TABLE 2. INTERVENING VARIABLES ASSOCIATED WITH THE DEVELOPMENT OF UTERINE ATONY.

Other factors		Hemorrhage from uterine atony				p	OR (95% CI)
		Yes		No			
		Frequency	%	Frequency	%		
Multiple pregnancy	Yes	139	13%	104	3%	0.000	4.48 (3.43-5.83)
	No	898	87%	3,007	97%		ref.
Polyhydramnios	Yes	11	1%	28	1%	0.642	1.18 (0.59-2.38)
	No	1,026	99%	3,083	99%		ref.
Dysfunctional labor	Yes	122	12%	212	7%	0.000	1.82 (1.44-2.31)
	No	915	88%	2,899	93%		ref.
Macrosomic fetus	Yes	113	11%	255	8%	0.000	1.37 (1.08-1.73)
	No	924	89%	2,856	92%		ref.
Total		1,037	100%	3,111	100%		

Source: Hospital Regional Docente de Trujillo - Data collection forms 2009 - 2019.



icant were multiple pregnancy [OR 4.48 (95% CI 3.43-5.83)], dysfunctional delivery [OR 1.82 (95% CI 1.44-2.31)] and macrosomic fetus [OR 1.37 (95% CI 1.08-1.73)].

The multivariate analysis in Table 3 of the independent factors associated with the development of uterine atony shows that both educational level and marital status were not statistically significant.

In the multivariate analysis (Table 4) of the independent factors associated with the development of uterine atony, it was observed that being great multiparous was not statistically significant, p value = 0.145 [OR 1.261 (95% CI: 0.923-1.724)].

DISCUSSION

The factors associated with the development of uterine atony can be identified, allowing us to predict the risk and thus minimize the consequences in the postpartum period by performing an early intervention to reduce patient morbidity and mortality.

TABLE 3. MULTIVARIATE ANALYSIS OF FACTORS ASSOCIATED WITH THE DEVELOPMENT OF UTERINE ATONY.

Factors	p	OR	95% C.I. for OR	
			Inferior	Upper
Cesarean delivery	0.000	1.699	1.454	1.986
Number of gestations	0.000			
Primiparous	0.001	0.723	0.598	0.875
Multiparous	0.003	0.757	0.629	0.911
Great multiparous	0.227	1.221	0.883	1.689
Marital status	0.167			
Single	0.458	2.206	0.272	17.865
Married	0.385	2.527	0.313	20.436
Cohabitant	0.332	2.800	0.349	22.29
Grade of education	0.011			
Elementary school	0.676	0.875	0.468	1.637
Secondary	0.872	1.052	0.567	1.950
Non-university higher education	0.349	0.733	0.383	1.405
University	0.411	0.746	0.371	1.500
Origin of the highlands	0.007	1.361	1.087	1.703
Multiple pregnancy	0.000	4.363	3.316	5.740
Dysfunctional delivery	0.000	1.565	1.222	2.005
Macrosomic fetus	0.002	1.455	1.142	1.852
Constant	0.030	0.090		

Multiple logistic regression, $p < \text{significant}$
Source: Hospital Regional Docente de Trujillo - Data collection sheets 2009 - 2019.

TABLE 4. MULTIVARIATE ANALYSIS OF FACTORS ASSOCIATED WITH THE DEVELOPMENT OF UTERINE ATONY.

Factors	p	OR	95% C.I. for OR	
			Inferior	Upper
Cesarean delivery	0.000	1.691	1.448	1.975
Number of gestations	0.000			
Primiparous	0.003	0.749	0.621	0.904
Multiparous	0.009	0.789	0.660	0.942
Great multiparous	0.145	1.261	0.923	1.724
Origin from the highlands	0.004	1.379	1.108	1.718
Multiple pregnancy	0.000	4.357	3.317	5.723
Dysfunctional delivery	0.000	1.577	1.232	2.018
Macrosomic fetus	0.003	1.438	1.130	1.830
Constant factor	0.000	0.224		

*Multiple logistic regression
** $p < 0.05$ significant
Source: Hospital Regional Docente de Trujillo - Fichas de recolección de datos 2009 - 2019.

Among the associated factors in the study was cesarean section; 67% of the patients had PPH due to uterine atony in comparison to the control group, where 50% of patients did not have this result, $p = 0.000$ [OR 1.98 (95% CI: 1.71-2.29)]. Cesarean section as the route of delivery was significantly 1.98 times more likely to result in PPH due to uterine atony. This data is related to the results of Gil's studies, where cesarean section patients had 6.64 times more risk of uterine atony in contrast to patients who delivered vaginally⁽¹³⁾.

The demographic factor associated with the development of uterine atony was being from the highlands: 14% of patients had PPH compared to the control group with 10%, $p = 0.003$ [OR 1.38 (95% CI 1.12 to 1.70)]. Patients from the highlands were significantly 1.38 times more likely to have PPH due to uterine atony. This result is like that of Altamirano, in Huancaavelica, a highland region, where 55.2% of postpartum women had atony⁽¹⁵⁾.

Being multiparous was not an associated factor for the development of uterine atony, with $p=0.001$ [OR 0.82 (95% CI: 0.69-0.97)] statistically significant, which agrees with Machado, who also found no association between multiparity and PPH due to uterine atony⁽¹⁶⁾.

In relation to the intervening variables that presented statistical significance and were as-



sociated with the development of uterine atony was dysfunctional labor, since 12% of the patients had PPH due to uterine atony compared to 7% of the control group, $p=0.000$ [OR 1.82 (95% CI: 1.44-2.31)]. This result is similar to that of Jiménez, where dysfunctional labor accounted for 70.4% of the cases vs. 36.1% of the controls⁽¹⁷⁾.

Another associated factor was multiple pregnancy; 13% of the pregnant women had PPH due to uterine atony compared to 3% of the control group, $p=0.000$ [OR 4.48 (95% CI: 3.43-5.83)]. Multiple pregnancy was significantly 4.48 times more likely to cause PPH due to uterine atony, having similarity with Ponce's study which found that 4.7% of postpartum women with uterine atony were significantly associated with multiple gestation ($p=0.017$). In addition, it was found that postpartum women with multiple gestation had 10.5 times more uterine atony than postpartum women without multiple gestation⁽¹⁸⁾.

The macrosomic fetus was an associated factor, since 11% of the patients had PPH due to uterine atony compared to the control group, 8%, $p=0.000$ [OR 1.37 (95% CI: 1.08-1.73)]. Our results were similar to those of Gutierrez, since 43.3% of the puerperal women who presented uterine atony had macrosomia as a significant associated factor ($p=0.003$) [OR 4.79 (95% CI 3.37-6.80)]⁽¹⁹⁾.

In conclusion, the present study showed that there are factors associated with the development of uterine atony such as cesarean section as the route of delivery, being from the highlands, having had a macrosomic fetus, polyhydramnios, and multiple pregnancy.

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