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Association between the macroscopic characteristics of the umbilical cord, high-risk pregnancy and neonatal repercussions

Associação entre as características macroscópicas do cordão umbilical, gestação de alto risco e repercussões neonatais

Asociación entre las características macroscópicas del cordón umbilical, gestación de alto riesgo y repercusiones neonatales

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ABSTRACT

Objective: To verify the association between the macroscopic characteristics of the umbilical cord, high-risk pregnancy and neonatal repercussions. **Method:** A cross-sectional study carried out from January 2012 to January 2015 in a public maternity hospital in Goiânia/GO. The study population consisted of 126 recent puerperal women with diagnosis of high-risk pregnancy, and 139 clinically normal women (control group). Macroscopic features of the umbilical cord, maternal, fetal and neonatal diseases, gestational age, Apgar score, birth weight, head circumference and parity were evaluated. Data were descriptively analyzed. **Results:** 265 puerperal women and their respective newborns participated in the study. The most frequent characteristics of the umbilical cord of those with high-risk pregnancy and those from the control group were the absence of true knots (97.6% and 2.4%, respectively), length between 35 and 70 centimeters and paracentral insertion (81.7% and 18.3%). A statistical difference was observed between the high-risk pregnancy group and extremes of maternal age (p=0.004). **Conclusion:** The analysis and description of the characteristics of the umbilical cord carried out by the nurse lend important information about the neonatal prognosis. This evaluation subsidizes clinical practice and seeks to ensure the safety of the (mother-baby) binomial throughout the perinatal period.

DESCRIPTORS

Umbilical Cord; Pregnancy High-Risk; Infant Newborn; Maternal-Child Nursing; Perinatal Care.

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INTRODUCTION

In the gestational process, the line between normality and disease is extremely thin and the imbalance represents a high risk of maternal-fetal morbidity and mortality[1-2]. About 20% of pregnancies have some type of complication[3]. Thus, women with alterations during pregnancy constitute a group known as "high-risk pregnant women"; a small number of pregnant women who have specific characteristics or because they suffer some injury are more likely to develop an unfavorable pregnancy[4].

In Brazil, high-risk pregnancies occur in 10% to 20% of the cases and are related to the occurrence of some disorders, the most frequent of which are gestational hypertension (GH) and gestational diabetes *mellitus* (GDM)[5]. Nearly 3/4 of maternal deaths in the world occur due to direct obstetric causes, and among them deaths due to hypertensive disorders represent about 14%[6].

There is a close relationship between placenta/umbilical cord, fetus and the change in its functions, as in the cases of GH and GDM. This relationship establishes different patterns of pregnancy outcomes and also the evolution of fetal and/or maternal injury[3]. The umbilical cord is an essential structure for maintenance of intrauterine life, and it can be used for assessing adverse perinatal conditions, thus contributing to a good neonatal prognosis[7]. This evaluation is performed through the macroscopic identification of umbilical cord alterations, and could, for example, elucidate causes of perinatal hypoxia which are not evidenced in the clinic, thus providing a better understanding of the physiopathogenesis of fetal events.

It is important that obstetricians and neonatal nurses have the necessary knowledge to perform macroscopic examination of the umbilical cord in the delivery room, as any identified alteration may have repercussions on the neonatal prognosis in the first 24 hours of extrauterine life.

Therefore, further investigation of the factors related to umbilical cord alterations caused by GH and GDM may help elucidate a number of questions related to the etiopathogenesis of gestational diseases and fetal/neonatal prognosis.

Therefore, the objective of this study was to verify the association between the macroscopic characteristics of the umbilical cord, high-risk pregnancy and neonatal repercussions.

METHOD

This is a cross-sectional study conducted from January 2012 to January 2015 in a public maternity hospital of a Federal Hospital integrated into the Unified Health System (SUS – *Sistema Único de Saúde*) of Goiânia – Goiás (GO), Brazil, founded in January 1962. It is a reference service in the State for providing care of women with high-risk pregnancy, in addition to other Brazilian regions such as the North and Northeast regions. The referred maternity has 23 beds, and all the service provided is linked to the SUS.

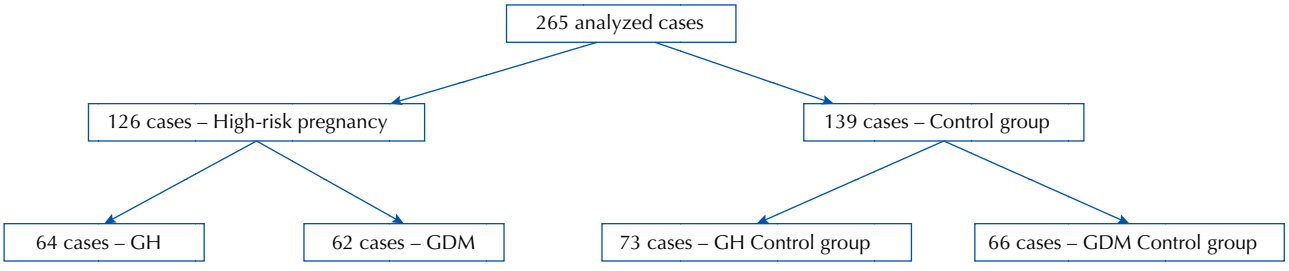
The population consisted of 265 puerperal women and their respective newborns (NB); of these, 126 were high-risk pregnancies – 64 with clinical diagnosis of GH and 62 with GDM; while 139 comprised the control group, 73 constituting the GH control group and 66 the GDM control group (Figure 1).

Placenta storage and analysis for all performed births is not a routine adopted by the service. The placentas are stored and sent to the pathology service only in cases of fetal/neonatal death or cases with clinical indication. For this reason, all cases in which the placenta was intact and available for evaluation were consecutively recruited and then collected during the delivery by the research team and stored at a temperature of approximately 25°C in 0.9% saline solution.

The control group consisted of women without high-risk pregnancy, newborns of mothers who did not present any diseases or complications during pregnancy and delivery as evidenced in the laboratory results, as well as clinically normal neonates. The medical records of all cases were made available for data collection with complete information, containing birth weight and gestational age. Participants signed the Free and Informed Consent Form (TCLE).

Data collection took place in three distinct stages: medical record revision, interview and macroscopic placental anatomopathological analysis. The protocols of Driscoll and Langston were used to analyze the umbilical cord[8]. The parameters evaluated in the macroscopic examination were: larger and smaller placental disc diameter, type of insertion, length of the umbilical cord, number of vessels, distribution of fetal vessels and the appearance of Wharton's jelly.

The criteria for non-inclusion were: all cases that did not meet the eligibility criteria; all cases where the placenta was not available for analysis; all cases in which the medical



Source: Elaborated by the authors.

Figure 1 – Flowchart of the study population, Goiânia, Goiás, 2017.

record was not available, was incomplete or had missing information such as birth weight and/or gestational age; or refusal on the part of the woman or her responsible to sign the TCLE and participate in the study.

The information source for this study was composed of medical records of each woman and her newborn, from which sociodemographic data (age, origin, schooling, profession, family income), maternal, fetal and neonatal diseases, gestational age (determined by the date of the last menstrual period, the first trimester ultrasound examination and the Capurro Method), the value of the Apgar index in the first and fifth minutes, the birth weight, the cephalic perimeter and parity were collected and transcribed onto another form. Maternal underlying diseases were grouped according to the criteria established by the 10th Revision of the International Classification of Diseases (ICD-10). Fetal and neonatal underlying diseases were grouped according to criteria established by Cartlidge and Stewart[9].

The ethical principles of research involving human beings were respected in accordance with Resolution 466/12. The research project was submitted and approved by the Committee of Ethics in Human and Animal Medical Research of the *Hospital das Clínicas* of the Universidade Federal de Goiás, under protocol number 101/2008.

The information was analyzed by the electronic program SigmaStat®, version 2.0. Quantitative data were analyzed descriptively through frequency distribution, means and standard deviation. Significance tests appropriate to the sample size were applied to verify statistical differences between proportions. The proportions were compared by the c^2 test, followed by Fisher's exact test or Yates correction test. Statistically significant differences were observed in which *p* was less than 5% ($p<0.05$).

RESULTS

The study population was comprised of 265 puerperal women and their respective newborns. Among the macroscopic characteristics evaluated in the umbilical cord, the most frequent was length between 36 and 70 cm in women with GDM (50%) and GH (53%), and paracentral insertion in the GDM (87%) and GH groups (76.5%) (Table 1).

The obstetric characteristic that most stood out was maternal age higher or equal to 36 years of age in the high-risk pregnancy group when compared to the control group ($p=0.004$), and gestational age less than 37 weeks in both high-risk pregnancy and control groups (Table 2).

Regarding the clinical conditions of the newborns of women affected by GH, 19 (29.6%) had a cephalic perimeter smaller than 32 cm and weight lower than 2,500 g, and 24 newborns (37.5%) scored less than 8 points on the Apgar index at 1 minute when compared to the GH control group. Regarding the women affected by GDM, the most frequent condition when compared to the GDM control group was the weight of the neonate being greater or equal to 4,000 g, being statistically significant (Table 3).

Table 1 – Macroscopic characteristics of the umbilical cord of women from the high-risk pregnancy group and the control group in a Federal Public Maternity Ward – Goiânia, Goiás, Brazil, 2015.

Macroscopic characteristics of the umbilical cord	GH	Control group GH		GDM	Control group GDM	
	n(%)	n(%)	*p-value*	n(%)	n(%)	*p-value*
Length						
≤35 cm	5(7.8)	9(12.3)		10(16.1)	6(9)	
36-70 cm	53(82.8)	60(82.1)	0.67	50(80.6)	56(84.8)	0.96
>70 cm	6(9.3)	4(5.4)		2(3.2)	4(6)	
Diameter						
<1,5 cm	3(4.6)	5(6.8)		1(1.6)	8(12.1)	
1,5-2 cm	31(48.4)	38(52)	0.67	41(66.1)	31(46.9)	1.00
>2 cm	30(46.8)	30(40)		20(32.2)	27(40.9)	
Insertion						
central	6(9.3)	12(16.4)		3(4.8)	11(16.6)	
paracentral	49(76.5)	56(76.7)	0.67	54(87.0)	53(80.3)	1.00
marginal	3(4.6)	2(2.7)		1(1.6)	2(3)	
velamentous	6(9.3)	3(4.1)		4(6.4)	0(0)	
Vessels						
3	63(98.4)	72(98.6)	1.00	62(100)	65(98.4)	1.00
2	1(1.5)	1(1.3)		0(0)	1(1.5)	
Knots						
Absent/False	63(98.4)	73(100)	1.00	60(96.7)	66(100)	1.00
True knots	1(1.5)	0(0)		2(3.2)	0(0)	
Total	**64(100)**	**73(100)**		**62(100)**	**66(100)**	

GH: gestational hypertension; GDM: gestational diabetes *mellitus*; n: number of cases; %: percentage; cm: centimeters; *p-value*: Mann-Whitney test.

Table 2 – Distribution of maternal age and gestational age of women in the high-risk pregnancy group and control group in a Federal Public Maternity Ward – Goiânia, Goiás, Brazil, 2015.

	High-risk pregnancy group		Control group	
	n(%)	*p-value*	n(%)	*p-value*
Maternal age				
≤18 years	8(6.3)	0.45	29(20.8)	0.45
19-35 years	103(81.7)	0.12	103(74.1)	0.12
≥36 years	15(11.9)	4	7(5.0)	4
Total	**126(100)**		**139(100)**	
Gestational age				
<37 weeks	28(22.2)	1.00	36(25.8)	1.00
37 weeks – 41 weeks and 6 days	97(76.9)	0.61	101(72.6)	0.61
>41 weeks and 6 days	1(0.7)	0.89	2(1.4)	0.89
Total	**126(100)**		**139(100)**	

n: number of cases; %: percentage; high-risk pregnancy: puerperal women affected by gestational hypertension and gestational diabetes *mellitus*; *p-value*: Student's t-test or Mann-Whitney test.

Table 3 – Clinical conditions of the newborns of women in the high-risk pregnancy group and the control group in a Federal Public Maternity – Goiânia, Goiás, Brazil, 2015.

Clinical condition of the newborns	GH	Control group GH		GDM	Control group GDM	
	n(%)	n(%)	*p-value*	n(%)	n(%)	*p-value*
CP						
< 32 cm	19(29.6)	10(13.6)		0(0)	7(10.6)	
32-38 cm	45(70.3)	63(86.3)	1.00	62(100)	59(89.3)	1.00
> 38 cm	-(0)	-(0)		-(0)	-(0)	
Total	**64(100)**	**73(100)**		**62(100)**	**66(100)**	
Weight						
<2,500 g	19(29.6)	5(6.8)		3(5.0)	3(4.5)	
2,500 – 3,999 g	44(68.7)	65(89.0)	1.00	55(88.3)	62(93.9)	0.003
≥4,000 g	1(1.5)	3(4.1)		4(6.6)	1(1.5)	
Total	**64(100)**	**73(100)**		**62(100)**	**66(100)**	
Apgar Index (score)						
1st min						
≥8	40(62.5)	56(73.7)	1.00	47(75.4)	53(80.3)	1.00
<8	24(37.5)	17(23.2)		15(24.5)	13(19.6)	
Total	**64(100)**	**73(100)**		**62(100)**	**66(100)**	
5th min						
≥8	61(95.3)	70(95.8)	1.00	62(100)	63(95.4)	1.00
<8	3(4.6)	3(4.1)		0(0)	3(4.5)	
Total	**64(100)**	**73(100)**		**62(100)**	**66(100)**	

GH: gestational hypertension; GDM: gestational diabetes *mellitus*; n: number of cases; %: percentage; cm: centimeters; g: grams, min: minute; *p-value*: Student's t-test or Mann-Whitney test.

DISCUSSION

The length of the umbilical cord varied between 36 and 70 cm, and the most common insertion type was paracentral. The obstetric characteristic that most stood out was maternal age greater or equal to 36 years among the high-risk pregnancy group, (p=0.004) and gestational age less than 37 weeks both in the high-risk pregnancy group and in the control group.

A study performed in pregnant women in the high-risk pregnancy group showed that the mean umbilical cord length was 62.2 ± 14.9 cm, while in the control group it was 59.30 ± 13.9 cm[10]. The increased length of the umbilical cord is related to increased intrauterine fetal movement, which happens in some high-risk pregnancy cases, especially in those related to the use of antidepressants[10]. The results found in this study show a higher frequency of paracentral insertion than central, marginal or velamentous insertions related to GH (p=0.67), both in the high-risk pregnancy group and in the control group.

In comparing the occurrence of macroscopic changes in the umbilical cord of women of the high-risk pregnancy group and the control group, no statistically significant difference was found. The literature describes maternal age at the extremes of reproductive life as a risk factor for complications in pregnancy[6,11]. A study of 468 patients who had abnormal umbilical cord insertion found a mean age of 36.5 ± 12.4 years and a mean gestational age of 21.83 ± 7.1 weeks[2]. In Saudi Arabia, a statistically significant

relationship between endothelial changes of the umbilical cord and the GH group (pre-eclampsia group) was found among the 85 patients evaluated[12].

Our results demonstrated a statistically significant relationship between the high-risk pregnancy group (GH and GDM) and extremes of maternal age (p=0.004). However, they did not present significance between gestational age in women affected by GH and GDM. In a study that aimed to determine morphometric parameters of the umbilical cord, the mean calculated gestational age was 33.7 ± 5.8 weeks[7]. Women with GH are predisposed to a shorter gestational period[12], findings that resemble our results considering that 28 (22.22%) of the women with high-risk pregnancies had a gestational age of less than 37 weeks.

GH causes a significant impact on the health of the mother and the fetus/neonate, since it leads to placental insufficiency[11]. Women with GH more often present a decrease in the umbilical cord length than women without it[13]. However, our data indicate that women with GH (82.8%) and GDM (82.1%) had a higher frequency of umbilical cord measuring between 36 and 70 cm. GH and GDM conditions may be associated with increased risk of altered umbilical cord insertion[14].

Intrauterine growth restriction and low birth weight of newborns from mothers with GH diagnosis during pregnancy are pointed out as a result of an adaptive fetal response to the damage[12]. A scientific investigation in France found a statistically significant relationship between restricted fetal growth and macroscopic abnormalities of the umbilical cord[15]. Birth weight is an important parameter for determining the risks of neonatal mortality[16].

In our study, 19 (29.6%) women with GH gave birth to low birth weight infants; a high number when compared to other similar studies in which only 9% of women with GH had newborns with low birth weight[16]. Women who developed pre-eclampsia during pregnancy gave birth to newborns with a mean birth weight of 1,907 ± 85 grams[17].

In addition, analyzes showed that a large proportion of women with GH gave birth to newborns with weights between 2,500 and 3,999 grams (68.7%), which is considered suitable for the gestational age.

Regarding the data referring to birth weight equal to or greater than 4,000 grams, we found four (6.6%) newborns among women with GDM compared to the data of women in the control group which presented one case (1.5%), a statistically significant difference (p=0.003).

GDM is a known risk factor for excessive neonatal weight and fetal macrosomia, (defined as birth-weight over 4,000 g); this is still the most common fetal complication in GDM cases. Studies have shown that newborns from high-risk pregnancies are significantly more likely to develop inadequate neonatal clinical conditions and an unfavorable neonatal prognosis in which the risk of intrauterine growth restriction and neonatal death are high[18-19]. No statistically significant differences were found regarding the clinical conditions of neonates from the high-risk pregnancy group and the control group.

Cephalic perimeter is still an important measurement for indicating brain growth and its possible changes, where pathological brain growth is characterized by the presence of tumor, hydrocephalus and microcephaly[20]. Our findings indicate that 19 (29.6%) of the newborns from mothers affected by GH had a CP below 32 cm.

In its assistive and scientific character, nursing constantly needs new knowledge to subsidize an increasingly qualified professional action. There are several aspects that involve the importance of nurses' adequate performance in maternal and child health, and in high-risk pregnancy. Among them, we can cite correct and qualified performance throughout the pregnancy-puerperal cycle, which will influence the healthy birth desired by the family and professionals of the multidisciplinary team.

Moreover, evaluating the characteristics and main macroscopic alterations of the umbilical cord is of extreme importance, since it seeks to prevent future perinatal complications. Therefore, a more in-depth investigation of the factors related to umbilical cord changes caused by GH and GDM is required. This investigation is essential so that innumerable questions about the etiopathogenesis of gestational diseases and about the fetal/neonatal prognosis can be elucidated and the benefits can be applied in the daily clinical practice of neonatal nursing.

This study presents some limitations due to being a descriptive cross-sectional study that used data from medical records and macroscopic anatomopathological analysis of the umbilical cord. Some information was often incompletely or inadequately recorded without standardization of the records; thus, some of the information was lost such as the maternal (underlying) disease history or the anthropometric data of the newborn due to illegible handwriting and a lack of records by the nursing team.

CONCLUSION

The results of this study showed a statistically significant association between the macroscopic characteristics of the umbilical cord and high-risk pregnancy, mainly in relation to GH/GDM groups and extremes of maternal age. No association between macroscopic umbilical cord characteristics and neonatal repercussions were found. However, some findings were quantitatively relevant, such as the group of high-risk pregnancy affected by GH presenting low birth weight newborns.

Considering the numerous complications that can be found in newborns of high-risk pregnancies, we highlight the importance of nurses analyzing the umbilical cord soon after delivery. The macroscopic analysis of its characteristics and alterations may provide important information about the neonatal prognosis. This evaluation subsidizes clinical practice and seeks to ensure the safety of the (mother-baby) binomial throughout the perinatal period.

Characterizing umbilical cord changes contributes to the neonatal diagnosis, as it can, for example, elucidate causes of perinatal hypoxia not evidenced in the clinic, providing a better understanding of the physiopathogenesis of fetal events.

Thus, in the case of an unfavorable prognosis for newborns, nurses specialized in obstetrics and neonatology will be able to provide specific and quality care with the purpose of outlining care strategies that address the growth and developmental needs of the newborn and the child.

RESUMO

Objetivo: Verificar a associação entre as características macroscópicas do cordão umbilical, a gestação de alto risco e as repercussões neonatais. **Método:** Estudo transversal, realizado no período de janeiro de 2012 a janeiro de 2015 em uma maternidade pública de Goiânia/GO. A população foi constituída de 126 puérperas com diagnóstico de gestação de alto risco e 139 clinicamente normais (grupo controle). Foram avaliadas características macroscópicas do cordão umbilical, doenças de base maternas, fetais e neonatais, idade gestacional, índice de Apgar, peso ao nascer, perímetro cefálico e paridade. Os dados foram analisados descritivamente. **Resultados:** Participaram do estudo 265 puérperas e seus respectivos recém-nascidos. As características mais frequentes do cordão umbilical de puérperas com gestação de alto risco e grupo controle foram a ausência de nós verdadeiros (97,6% e 2,4%, respectivamente), comprimento entre 35 e 70 centímetros e inserção paracentral (81,7% e 18,3%). Houve diferença estatística entre o grupo gestação de alto risco e extremos de idade materna (p=0,004). **Conclusão:** A análise e a descrição das características do cordão umbilical, realizadas pelo/a enfermeiro/a, trazem informações importantes sobre o prognóstico neonatal. Essa atribuição subsidia a prática clínica e visa à segurança ao binômio durante todo o período perinatal.

DESCRITORES

Cordão Umbilical; Gravidez de Alto Risco; Recém-Nascido; Enfermagem Materno-Infantil; Assistência Perinatal.

RESUMEN

Objetivo: Verificar la asociación entre las características macroscópicas del cordón umbilical, gestación de alto riesgo y repercusiones neonatales. **Método:** Estudio transversal, realizado en el período de enero de 2012 a enero de 2015 en una maternidad pública de Goiânia/GO. La población estuvo constituida de 126 puérperas con diagnóstico de gestación de alto riesgo y 139 clínicamente normales (grupo control). Fueron evaluadas características macroscópicas del cordón umbilical, enfermedades de base maternas, fetales y neonatales, edad gestacional, índice de Apgar, peso al nacer, perímetro cefálico y paridad. Los datos fueron analizados descriptivamente. **Resultados:** Participaron en el estudio 265 puérperas y sus respectivos recién nacidos. Las características más frecuentes del cordón umbilical de puérperas con gestación de alto riesgo y grupo control fueron la ausencia de nudos verdaderos (el 97,6% y el 2,4%, respectivamente), longitud entre 35 y 70 centímetros e inserción paracentral (el 81,7% y el 18,3%). Hubo diferencia estadística entre el grupo gestación de alto riesgo y extremos de edad materna (p=0,004). **Conclusión:** El análisis y la descripción de las características del cordón umbilical, realizadas por el/la enfermero/a, brindan informaciones importantes acerca del pronóstico neonatal. Dicha atribución subsidia la práctica clínica y tiene como fin la seguridad del binomio durante todo el período perinatal.

DESCRIPTORES

Cordón Umbilical; Embarazo de Alto Riesgo; Recién Nacido; Enfermería Maternoinfantil; Atención Perinatal.

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