

Post-spinal Anesthesia Headaches in Obstetric Resource-limited Settings: Epidemiological and Clinical Characteristics, Determinants and Predictive Score

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ABSTRACT

Background: Post-spinal anesthesia headaches remain a problem in the world. The objective of this work was to evaluate their epidemiological and clinical characteristics, their determinants as well as the elaboration of an adapted predictive score in obstetric medium of resource-limited countries.

Methods: This was a descriptive and analytical observational study of 546 patients for 7 months in 6 hospitals in DR Congo. After multivariate analysis, the logistic regression was used to develop the predictive score with discrimination assessed using the ROC curve and calibration using the Hosmer-Lemeshow test.

Results: The prevalence was 27.5%. Significant determinants were: history of spinal anesthesia, L2-L3 puncture level, puncture attempts > 3, needle diameter < 25 gauge, overweight, low operator level, age > 35 years, parity 1 and > 5, Quincke's needle as well as urgent interventions. Eight significant parameters rated from 1 to 2 resulted in a total score of 10 (< 6 low risk, 6-7 moderate risk, and ≥ 8 high risk). The area under the ROC curve was 0.90 with a sensitivity of 66%, a specificity of 90.6%, a VPN of 87.3%, and a PPV of 72.8%.

Conclusion: The determinants of these headaches specific to our environment have been identified and have made it possible to develop a simple and reproducible predictive score that could allow screening, diagnostic orientation and even prophylactic treatment.

Keywords

Headache, Rachianesthesia, Obstetrics, Determinants, Predictive score, DR Congo.

Highlights

- Headaches post-spinal anesthesia remains a real public health problem, not only because of their high frequency, but also because of their determinants specific to our environment and duly identified.
- Some of these determinants, however significant in our study, are not yet described in the literature in particular: advanced age ≥ 35 years, overweight, antecedent spinal anesthesia, parity 1 and ≥ 5 , degree of urgency, the L2-L3 puncture level and the number of puncture attempts ≥ 3 .
- This allowed us to develop a simple and reproducible predictive score that would detect patients at risk, facilitate diagnostic orientation, as well as consider perioperative prophylactic measures.

Introduction

Spinal anesthesia, which has become widely accepted in recent years, has become the anesthetic technique of choice for scheduled or urgent cesarean sections [1-3]. As a renewal of interest, it combines the qualities of the epidural, advantages such as its relative simplicity, its efficiency, the low rate of failures, its rapid installation allowing its use in emergency, the excellent surgical conditions and the low quantity of local anesthetics administered decreasing the risk of toxic reactions in the mother and / or fetus [3,4]. Post dural puncture headache (CPPD) is a non-exceptional and debilitating iatrogenic complication that is a long-standing challenge for anesthetists and resuscitators [5-7].

They were described for the first time by August Bier in 1898 as intense headaches, appearing rapidly after spinal anesthesia, improved by the supine position, and aggravated by orthostatism and sitting, accompanied by auditory, ocular and digestive signs [8,9]. More than a century later, all the questions concerning their pathophysiology and their management still leave a lot of dark spots [9]. Several therapeutic measures have been studied, but none has been highly effective except for the Blood patch, which also has some limitations in its practice [8,10].

Among the risk factors known today we have: the female sex, the young age, the size of the needle, the number of tests to locate the space under arachnoid as well as the level of the operator [4,7,11]. The incidence is higher in pregnant women probably due to the decrease of the postpartum intra-abdominal pressure contributing to the leakage of cerebrospinal fluid (CSF) by the reduction of the pressure in the epidural space. In addition, hormonal changes after delivery by vasodilatation on the cerebral vessels predispose to post-spinal anesthesia headaches (AKFC).

In Africa, the few studies done have tried to show the same limitations in terms of management, with an increased prevalence especially in the obstetric environment due to lack of equipment and qualified personnel [2, 7]. To date, this trend has not led to

concrete and sustainable solutions based on the realities of certain African terrains, particularly the DR Congo, where a development in the Great Lakes Medical Review had shown the need to look for specific determinants. This environment in order to propose adapted preventive measures starting from a predictive score [5]. This is very important because it is difficult to act downstream if the risk factors specific to the environment are not known. This is why we have set ourselves the task of conducting this study, which aims to contribute to the understanding of the determinants, predictives and evolutionary factors of the CAORP in our environment in order to open the way of preventive as well as specific orientations adapted to our local conditions.

Patients and Methods

Type of study: This was an observational study for descriptive and analytical purposes for the assessment of risk factors and determinants of OCAF.

Sites and study period: this work took place in hospitals in 3 provinces of South-East DR Congo, namely: North Kivu (Nursery Charity Hospital and Kyeshero Hospital), South Kivu (Hospital Biopharm and Skyborne) as well as in the Upper Katanga (Sendwe Provincial Hospital and Diamant Medical Center) for their high capacity, their academic vocation, the regular obstetric anesthetic practice and the presence of an anesthetist doctor during a period of 7 months (May 1st to November 31st 2018).

Study population: it was represented by patients undergoing spinal anesthesia for an obstetric indication and presenting characteristic headaches.

Sampling: Our sampling was of the exhaustive type.

Inclusion criteria: All patients undergoing spinal anesthesia for an obstetric indication and presenting characteristic headache without other known causes and whose informed consent was obtained.

Exclusion criteria: all cases of spinal anesthesia for a non-obstetrical indication, with non-characteristic headaches or related to another known cause, as well as non-consent.

Study Variables: As independent variables, we retained: socio-demographic and anthropometric characteristics, obstetric formula, time to onset, obstetric indication and degree of urgency, needle type and size, the number of attempts, the nature of the anesthetic products, the respect of the position, the level of the operator, the characteristics of the headaches and the length of stay. The variable to be explained was represented by headaches.

Data collection: it was done by the documentary technique from medical records, anesthesia files and fact sheets. The investigators were pre-trained and the data transmission was weekly.

Data Processing: Excel software was our database for further processing.

Analyses: univariate and multivariate, the logistic regression used in the development of the predictive score (significance level = $p < 0.05$).

Discrimination was assessed using the ROC curve with Hosmer-Lemeshow score calibration. The scoring of the score was obtained from the formula: $p = 1/1 + \exp(5.8655 - 0.9031 \times \text{score})$. The XL STAT 2015 software was used for data analysis.

The study was conducted with respect for confidentiality and with respect for human dignity.

Results

Prevalence, age and warning signs

The prevalence of CAART was 27.5% (150/545) and the mean age was 27.1 ± 6.4 years.

Most headaches (44%) occurred on postoperative day 2.

The main warning sign was neck pain (26%).

Unified and multivariate analysis

The main risk factors for CAART were: history of spinal anesthesia, L2-L3 puncture level, high number of puncture attempts, large diameter of the needle $< G25$, overweight, low operator level, age > 35 , parity 1 and > 5 , sharply angled Quincke needle, and urgent procedures. The other socio-demographic, obstetrical and anesthetic parameters did not show any significant association with post-spinal anesthesia headaches.

Determinants of CAARO in univariate analysis

The various parameters above associated with Odds-Ratios, were the main determinants of the CPRAO.

Logistic regression of the CPRAO score

As a result, eight parameters rated from 1 to 2: Overweight / Obesity (1), Parity 1 or ≥ 5 (1), Needle size ≤ 22 cm (2), History of spinal anesthesia (2), Puncture level L2-L3 (1), No respect position (1), Emergency intervention (1), Number of punctures ≥ 3 (1) were retained because of their specific weights for the development of the score scored at 10.

Rating of the CPARC Predictive Score

The presence of these eight criteria affects a certain number of points, the total of which is 10 points. For each patient, the score ranges from 0 to 10 and the higher it is, the higher the risk of headaches. The risk probabilities of headache as a function of the constructed score values were calculated and are presented in this table. A score < 6 defines patients at low risk of headache, a score between 6 and 7 points defines a moderate risk of headache and a score ≥ 8 points presents a high risk of occurrence of CPRAO.

Assessment of discrimination of the score and its calibration

The area under the ROC curve was 0.90.

Sensitivity, Specificity, Predictive Values

Sensitivity was 66%, specificity was 90.6%, Negative Predictive Value was 87.3%, and Positive Predictive Value was 72.8%.

Variable	Total (N=545)	Headache				OR Gross [95% CI]	P	
		Yes (n=150)		No (n=395)				
Age	<20 years	42	16	38,10%	26	61,90%	2,10 [1,08-4,09]	0,0414
	20-34 years	402	91	22,64%	311	77,36%	1,00	
	≥ 35 years	101	43	42,57%	58	57,43%	2,53 [1,60-4,01]	<0,0001
Parity	1	132	50	37,88%	82	62,12%	3,51 [2,19-5,63]	<0,00001
	2-4	304	45	14,80%	259	85,20%	1,00	
	≥ 5	109	55	50,46%	54	49,54%	5,86 [3,59-9,58]	<0,00001
BMI	Normal	353	75	21,25%	278	78,75%	1,00	
	Overweight	37	19	51,35%	18	48,65%	3,91 [1,95-7,82]	<0,0001
	Obesity	155	56	36,13%	99	63,87%	2,09 [1,38-3,17]	0,0006
Degree of urgency	Program	288	59	20,49%	229	79,51%	1,00	
	Emergency	257	91	35,41%	166	64,59%	2,13 [1,45-3,12]	<0,0001
Needle type	Quincke	335	119	35,52%	216	64,48%	3,18 [2,04-4,95]	<0,00001
	Sprotte & Whitacre	210	31	14,76%	179	85,24%	1,00	
Position	Seat	528	145	27,46%	383	72,54%	1,00	
	Lateral Décubitus	17	5	29,41%	12	70,59%	1,10 [0,38-3,18]	1,0000
Spinal static	Normal	509	139	27,31%	370	72,69%	1,00	
	Abnormal	36	11	30,56%	25	69,44%	1,17 [0,56-2,44]	0,8192
Respect for the position	No	234	91	38,89%	143	61,11%	2,72 [1,85-4,00]	<0,00001
	Yes	311	59	18,97%	252	81,03%	1,00	
Operator level	Acting as anesthetist	37	22	59,46%	15	40,54%	14,67 [6,23-34,52]	<0,00001
	Nurse anesthetist	354	114	32,20%	240	67,80%	4,75 [2,62-8,59]	<0,00001
	Anesthetist	154	14	9,09%	140	90,91%	1,00	

Puncture level	L2-L3	203	77	37,93%	126	62,07%	2,35 [1,49-3,70]	0,0003
	L3-L4	184	38	20,65%	146	79,35%	1,00	
	L4-L5	158	35	22,15%	123	77,85%	1,09 [0,65-1,83]	0,8374
Needle size	>22 cm	210	31	14,76%	179	85,24%	1,00	
	22 cm	335	119	35,52%	216	64,48%	3,18 [2,04-4,94]	<0,00001
Number of punctures	<3	178	10	5,62%	168	94,38%	1,00	
	≥3	367	140	38,15%	227	61,85%	10,36 [5,29-20,28]	<0,00001
History of spinal anesthesia	No	311	51	16,40%	260	83,60%	1,00	
	Yes	234	99	42,31%	135	57,69%	3,74 [2,51-5,56]	<0,00001
Type of local anesthetics	Bupivacaina	464	130	28,02%	334	71,98%	1,00	
	Others	81	20	24,69%	61	75,31%	0,84 [0,49-1,45]	0,6286
Adjuvant product	Fentanyl	268	76	28,36%	192	71,64%	1,00	
	Others	277	74	26,71%	203	73,29%	0,92 [0,63-1,34]	0,7387

Table 1: Analysis of the explanatory variables as a function of their weight in the occurrence of post-spinal anesthesia headaches in obstetrics. The main determinants with significance were: antecedents of spinal anesthesia, puncture level L2-L2, high number of puncture attempts, large diameter of the needle < G25, overweight, low level of the operator, 1 age > 35, parity 1 and > 5, sharply angled Quincke needle, and urgent procedures. Other sociodemographic, obstetrical and anesthetic parameters were not significant.

Variable	Adjusted OR	At 95% CI	Coefficient	Score
Overweight/Obesity	2,36	1,38-4,05	0,86	1
Parity 1 ou ≥ 5	3,83	2,19-6,70	1,34	1
Needle size ≤ 22 cm	9,87	5,51-17,68	2,29	2
Number of punctures ≥ 3	2,88	1,33-6,22	1,06	1
Emergency	2,04	1,17-3,51	0,71	1
Puncture level L2-L3	2,30	1,35-3,92	0,83	1
No-respect for the position	2,89	1,68-4,97	1,06	1
History of spinal anesthesia	7,04	3,90-12,69	1,95	2

Table 2: Logistic Regression Model of Headache Risk and Predictive Factor Score. As a result, eight parameters rated from 1 to 2: Age > 35 and <20 years (1), overweight (1), parity 1 or > 5 (1), needle <G25 (2), history of spinal anesthesia (2), puncture level L2-L3 (1), non-compliance position (1), low operator level (1), urgent intervention (1), > 3 attempts were retained due to their specific weights for the development of the score at 10.

Score obtained	Probability of post-spinal obstetric anesthesia headaches *
0	0,2%
1	0,7%
2	1,7%
3	4,1%
4	9,5%
5	20,6%
6	39,0%
7	61,2%
8	79,6%
9	90,6%
10	95,9%

Table 3: Probability of post-spinal obstetric anesthesia headache by score using the logistic regression model. * obtained from the formula: $p = 1/1 + \exp(5.8655 - 0.9031 \times \text{score})$. The presence of these eight criteria affects a certain number of points, the total of which is 10 points. For each patient, the score ranges from 0 to 10 and the higher it is, the higher the risk of headaches. The risk probabilities of headache as a function of the constructed score values were calculated and are presented in this table. A score <6 defines patients

at low risk of headache, a score between 6 and 7 points defines a moderate risk of headache and a score ≥ 8 points presents a high risk of occurrence of post-spinal obstetric anesthesia headaches.

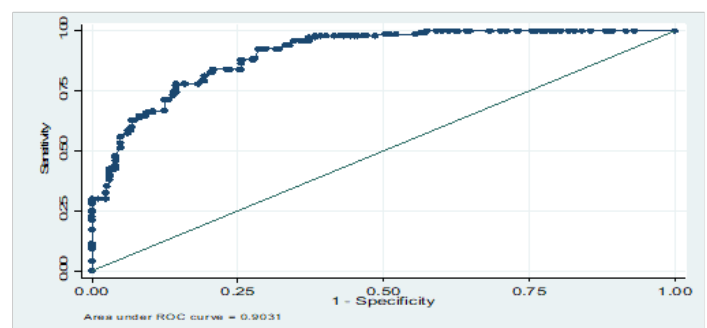


Figure 1: ROC curve for evaluation of score discrimination and calibration using the Hosmer-Lemeshow test. The area under the ROC curve was 0.90 with a sensitivity of 66%, a specificity of 90.6%, a VPN of 87.3%, and a PPV of 72.8%.

Discussion

Post-dural headache is still a serious problem in anesthetic practice in general and, in particular, in obstetric practice around the world. The magnitude of this situation is even greater in resource-limited countries where the problems of appropriate materials and qualified personnel arise, as well as the lack of mastery of the determinants of particular environments, particularly those in resource-limited countries. like the DR Congo.

Prevalence

The CAART represent 27.5% in our study and yet the overall global trend shows a significant decrease of 66% in 1898, 11% in 1956 and 1 to 4% today [8]. Our prevalence in the obstetric milieu seems higher compared to several Western and even African studies [2,11,12]. It is true that some literatures incriminate the predisposition of women compared to men [4,11], certain epidural vascular changes during pregnancy [15,14], but other numerous factors of bad practice of spinal anesthesia such as the level of the operator, the inadequate material... remain incriminated in our environment although other obstetrical determinants such as parity as well as maternal overweight have been found in this work.

Delay of occurrence

Starting from the creation of the breach with a significant leakage of the cerebrospinal fluid, the headaches appear on the second and third postoperative day and rarely beyond the seventh day [2,7,12]. The average delay in our study was 2 days, which is consistent with the literature, which still insists on the relative precocity of their occurrence according to the size of the gap and the leakage of the fluid [4,13].

Annunciators

The hypotension of the cerebrospinal fluid causes a cranio-caudal displacement of the encephalon which puts in tension the meningeal vasculo-fibrous structures of the convexity, partly responsible for the headache, by the activation of the stretch-sensitive meningeal receptors of the trigeminal nerves (frontal headache), glossopharyngeal nerves, and Wave (occipital headache) and the first three cervical roots (nuchal headache and cervico-scapular pain) [4]. In our context, neck pain followed by scapulargia was the most important sign of annoyance found for the predictive score. Other literatures also did not show this significance, although they still need to help the clinician for clinical guidance given multiple differential diagnoses [7,11-13].

Sociodemographic and anthropometric data

Age

Several studies have shown in general, and in particular in the obstetric milieu, the predisposition of young age without any real anatomical justification [2,7,11,13], but other meta-analyzes based on the size and type of the needle have showed average ages around 37 years old. Our study had also found the share of young age, but also with a particular significance in the over 35 years unlike other authors. This could be explained not only by inadequate practices of spinal anesthesia at any age in our environment, but also by age-related multiparity in obstetric settings. All in all, true age-

related anatomical reasons will need to be investigated in later studies because it is likely that spinal cord changes related to age and multiparity may have an impact on the occurrence of these headaches in a particular patient. obstetric context.

Weight

It is clear from this work that overweight or even obesity is an important risk factor, although this is not particularly sought after in obstetrics in some studies [2,7,11]. This could be explained by the fact that obesity leads to certain spinal modifications leading the operator to do several punctures at a time in order to identify the space, but also the turgidity of the epidural veins exposing to the great risk of dural breccia.

Other sociodemographic parameters

In our study, as in others [7,11,13], some variables such as origin, religion, and educational level were not associated with the occurrence of headaches.

Obstetric data

Female sex and pregnancy are cited as contributing factors in the literature, but few details to explain their involvement [2,7,8,11-13]. Among the obstetrical factors studied in this work, primiparity and multiparity were found as risk factors in the occurrence of headaches. Indeed, the primiparity could expose to several attempts of punctures due to the non-experience of the parturient face to this type of anesthesia, in addition to the fact of the young age. On the other hand, multiparity, due not only to medullary anatomical changes, but also to a history of spinal anesthesia, which is itself a risk factor, also emerged as one of the major factors in post-spinal anesthesia headache exposure. series; similarly, the degree of obstetric urgency was one of the risk factors for the simple reason that spinal anesthesia is the most common type of anesthesia performed in emergency caesarean sections [16,17]. In addition, the gestational and the indication of the cesarean section did not show a significant association in our study as in certain African series [2,7].

Anesthetic data

A dural breach can be either intentional, during spinal anesthesia or diagnostic or therapeutic lumbar puncture, or accidental when performing analgesia or epidural anesthesia. The recognized anesthetic risk factors for OW CRA are: the large diameter of the needle, the sharply angled Quincke needle, and the multitude of puncture attempts [4,6,7,11,12]. In addition to these factors, our work had incriminated the antecedent of spinal anesthesia, the no respect of position at the time of the puncture, as well as the level of puncture L2-L3 can be because this one is the most used [6,14]. All these parameters could be intricated either in the predispositions or anatomical fragilities, or in the numerous attempts of punctures favoring the occurrence of an accidental breach. On the other hand, as in other studies, our series did not show the place of the variables such as: the spinal statics, the type of local anesthetic or even its baricity or the adjuvant in the occurrence of headaches in obstetrical medium.

Predictive score

The problem of early diagnosis or screening of patients at risk will remain a real ordeal for the anesthetist practitioner in resource-limited countries if no tools are put in place for this purpose [5]. Such a tool will have to take into account certain determinants specific to certain environments because of the desertification of qualified anesthetists, the lack of appropriate equipment or even the low level of education of our patients. This work allowed us to develop a predictive score rated at 10, simple, reproducible and adapted to the determinants of our environment. This score could make it possible to consider preventive therapies for patients at risk, or even to help with the diagnostic orientation.

Conclusion

The OWCRA continues to be a serious problem in our environment with duly identified specific determinants, which have made it possible to develop a simple, reproducible and efficient predictive score for resource-limited countries. This score could make it possible to consider preventive therapies in patients at risk, or even facilitate the diagnostic orientation.

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