Accidental Dural Puncture and Post-dural Puncture Headache in the Obstetric Population: Eight Years of Experience

Punção Acidental da Dura e Cefaleia Pós-punção da Dura na População Obstétrica: Oito Anos de Experiência

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Acta Med Port 2016 Apr;29(4):268-274 ▪ http://dx.doi.org/10.20344/amp.6815

ABSTRACT

Introduction: Accidental dural puncture is an important complication of regional anesthesia and post-dural puncture headache remains a disable outcome in obstetric population. The aim of our study was to calculate the incidence of accidental puncture and post-puncture headache and evaluate its management among obstetric anesthesiologists.

Material and Methods: We conducted a retrospective audit, between January 2007 and December 2014. We reviewed the record sheets of patients who experienced either accidental puncture or post-puncture headache. We excluded the patients undergoing spinal block. We use the SPSS 22.0 for statistical analyses.

Results: We obtained 18497 neuro-axial blocks and 58 accidental dural punctures (0.3%). After detected puncture, in 71.4% epidural catheter was re-positioned and 21.4% had intra-thecal catheters. Forty-five (77.6%) developed headache and the prophylactic measures were established in 76.1%. Conservative treatment was performed in all patients. The epidural blood patch was performed in 32.8% with a 84.2% of success.

Discussion: The incidence of post-dural puncture headache is unrelated to the type of delivery or insertion of intrathecal catheter. The re-placement of the epidural catheter remains the main approach after puncture. The institution of prophylactic measures is a common practice, despite the low level of evidence. We performed epidural blood patch after failure of conservative treatment.

Conclusion: The incidence of accidental dural puncture and post-dural puncture headache was similar to the literature. Despite being a common complication, there remains lack of consensus on its approach.

Keywords: Analgesia, Epidural; Anesthesia, Obstetrical; Blood Patch, Epidural; Dura Mater; Post-Dural Puncture Headache.

RESUMO

Introdução: A punção acidental da dura é uma importante complicação da anestesia regional e a cefaleia pós-punção continua a ser causa de morbilidade na população obstétrica. O objetivo do nosso estudo foi calcular a incidência de punção acidental e cefaleia pós-punção no nosso Centro Hospitalar e avaliar a sua abordagem entre os anestesiologistas obstétricos.

Material e Métodos: Realizámos uma auditoria retrospetiva, entre janeiro de 2007 e dezembro de 2014. Revimos as folhas de registo das doentes em que ocorreu punção inadvertida da dura ou cefaleia pós-punção. Excluímos as doentes submetidas a bloqueio subaracnoideu. Utilizámos o SPSS 22.0 no tratamento estatístico dos dados.

Resultados: Obtivémos 18 497 bloqueios neuro-axiais e 58 punções acidentais da dura (0,3%). Após punção detetada, em 71,4% o cateter epidural foi re-posicionado e 21,4% tiveram cateteres intra-tecais. Quarenta e cinco (77,6%) desenvolveram cefaleia e a instituição de medidas profiláticas ocorreu em 76,1%. O tratamento conservador foi efetuado em todas as doentes. O *blood patch* epidural foi realizado em 32,8% com um sucesso de 84,2%.

Discussão: A incidência de cefaleia pós-punção não está relacionada com o tipo de parto ou a inserção do cateter intra-tecal. A re-colocação do cateter epidural mantém-se a abordagem de eleição após punção. A instituição de medidas profiláticas é uma prática comum, apesar do baixo grau de eficácia. Realizámos *blood patch* epidural após falência do tratamento conservador.

Conclusão: A incidência de punção inadvertida e cefaleia pós-punção foi semelhante à da literatura. Apesar de ser uma complicação comum, existe falta de consenso na sua abordagem.

Palavras-chave: Analgesia Epidural; Anestesia Obstétrica; Cefaleia Pós-Punção Dural; Dura-Máter; Placa de Sangue Epidural.

INTRODUCTION

Accidental dural puncture (ADP) is a major complication of neuroaxial anaesthesia and post-dural puncture headache (PDPH) is an adverse outcome in obstetric population.[1]

Pregnant mothers are considered at increased risk for PDPH when compared to other populations, due to their younger age and gender.[2] PDPH is a relevant cause for morbidity in pregnant mothers, explaining for an increased length of stay as well as additional costs in complementary investigations and therapy. There are also late-onset clinical presentations, explaining for the important role of Family Medicine physician's awareness on this complication of neuroaxial anaesthesia.

An ADP rate below 1% has been found in the UK and up to 80% of pregnant mothers described the presence of symptoms upon ADP.[1] Such rates have still not been determined in Portugal and there are currently different clinical approaches according to institutional guidelines whenever an ADP is recognized or suspected. Prophylactic measures regarding PDPH are still recommended, despite little evidence on efficacy. A conservative treatment is followed upon the development of any headache and/or

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Recebido: 16 de julho de 2015 - Aceite: 02 de novembro de 2015 |

epidural blood patch (EBP).

Our study aimed to determine the incidence rate of PDPH in the obstetric population attending our *Centro Hospitalar* as well as to assess the approach to this complication by obstetric anaesthetists.

MATERIAL AND METHODS

The study was approved by the Ethics Committee and was a retrospective study carried out in a tertiary care referral hospital where 21,772 deliveries took place between January 2007 and December 2014.

ADP or PDPH associated with epidural anaesthesia or analgesia as well as with epidural space research during neuroaxial combined spinal-epidural (CSE) technique were considered as inclusion criteria to our study and data were obtained from clinical records of the Anaesthesiology Department. Loss of resistance technique with saline and median approach (18-gauge Tuohy needle) were used for the identification of epidural space. CSE technique involved epidural blockade obtained with a needle, in which epidural space is searched according to the abovementioned method and dura is pierced with a pencil-point 27-gauge needle. ADP diagnosis was based on the presence of cerebrospinal fluid (CSF) leak through the needle or epidural catheter or the development of headache diagnosed according to the International Classification of Headache Disorders (ICHD-II criteria). To meet criteria, the patient needs to have a headache within 15 minutes after sitting or standing and improves within 15 minutes of lying down. The patient would need at least one of the following symptoms in association with the headache: neck stiffness, tinnitus, hypoacusis, photophobia or nausea. The headache would have occurred within 14 days upon confirmed or suspected ADP and should resolve spontaneously within one week or within 48 hours of receiving effective treatment (usually by epidural blood patch).[3]

Patients presenting with headache associated to spinal (subarachnoid) analgesia or anaesthesia and those presenting with complications unrelated to ADP were excluded from the study.

Patient medical records were revised and the following variables were considered: patient's age, week of pregnancy at the time when the event occurred, number of previous pregnancies, associated pathology and the American Society of Anesthesiologists (ASA) score, body mass index (BMI), delivery type, anaesthesia or analgesia technique, patient positioning, vertebral level of puncture site, CSF leak origin (needle *vs.* catheter), placement of a spinal catheter, implemented prophylactic measures upon ADP diagnosis, headache intensity and frequency according to pain numeric rating scale, associated symptoms, implemented conservative treatment, EBP incidence and outcome and length of stay.

Statistical analysis

IBM SPSS *Statistic* version 22.0 software was used in statistical analysis. Categorical variables were presented as absolute and relative frequencies and continuous variables as mean and range of values in descriptive analysis. Chi-square or Fisher's exact test were used in percentage comparison, whenever adequate. Student's *t*-test was used in comparison between continuous variables for independent samples. Statistical significance was considered for $p < 0.05$. Multiple regression models were obtained, although statistically significant results were not found (data not shown).

RESULTS

In total, 18,497 neuroaxial blockade procedures were performed between January 2007 and December 2014 (276 spinal, 15,110 epidural and 3,111 using CSE technique).

An average 30.4 (20-42, 95% CI) years of age was found in patients presenting with ADP whether having or not developed any headache, at an average 38.3 weeks of pregnancy (34-41, 95% CI). A 30 kg/m2 (19.1-44.9, 95% CI) average BMI was found and most of our patients gave birth vaginally (Table 1).

A 0.3% (58/18,221) ADP incidence rate, whether or not associated to any subsequent headache, was found in our patients; 72.4% of these presented with recognized ADP (42/58) and 27.6% (16/58) of the patients presented with headache upon an unrecognized accidental puncture. ADP (recognized or unrecognized) was associated to epidural technique in 89.7% of the patients and to CSE technique in

Table 1 - Demographic characteristics and type of birth in our group of patients

		ADP (n = 58)
Age (years), range (mean)		20.0 – 42.0 (30.4)
Gestational age (weeks), range (mean)		34.0 – 41.0 (38.3)
Gestations (n), range (mean)		1.0 – 7.0 (1.8)
ASA score, range (mean)		1 – 3 (1.47)
BMI (kg/m2), range (mean)		19.1 – 44.9 (30.0)
Type of birth, n (%)	Vaginal	38.0 (65.5)
	Caesarean section	20.0 (34.5)

n: number of patients; ASA: American Society of Anesthesiologists; BMI: Body mass index; ADP: accidental dural puncture.

10.3% (6/58). This latter group of patients (6/58) underwent an additional combined technique upon an accidental puncture with the epidural needle had occurred using a needle-through-needle technique in an adjacent lumbar interspace. Left lateral decubitus position was adopted by 69.9% (40/58) of the patients. CSF leak through epidural needle occurred in more than half of the patients (58.6%), including all the patients who underwent the CSE technique (Table 2).

Upon ADP diagnosis, epidural catheter re-siting through a different lumbar interspace was used in half of the patients (21/42), at the same lumbar interspace in 21.4% (9/42), into the intra-thecal space for 24 hours in 21.4% (9/42) and regional technique was abandoned in 7.2% (3/42) of the patients. Prophylactic measures, namely bed rest (until headache improvement, up to 48 hours), forced hydration (with 5% dextrose in 0.9% normal saline – intravenously, 125 ml/h and oral hydration), caffeine drinks (equivalent to 300-500 mg of caffeine, orally, 1-2xday), analgesics and/or non-steroidal anti-inflammatory drugs (acetaminophen, 1 g, orally, q8h and/or ibuprofen 400 mg, orally, q8h) (Table 3) were used for 76.1% (35/46) of the patients with recognized or unrecognized ADP.

PDPH affected 45 (77.6%) patients (Table 4). Symptom onset mostly (86.6%) occurred up to 48 hours upon ADP, although 6.7% of the patients developed headache upon 72 hours. All the patients, including those that did not develop headache (n=13), were recommended to attend the hospital in case of late-onset headache. Most patients (80.0%) rated their headache as moderate. A similar incidence of PDPH upon epidural and CSE (75% *vs.* 100%, $p > 0.05$) technique was found and was not related with patient positioning (left lateral decubitus – 77.5% *vs.* sitting – 77.8%, $p > 0.05$) or whether the catheter was placed in epidural or intra-thecal space (82.2% *vs.* 55.6%, $p > 0.05$). No association was found between PDPH and the type of delivery (vaginal – 73.7% *vs.* caesarean-section – 85.0%, $p > 0.05$).

Conservative treatment (bed rest, forced hydration, caffeine drinks, analgesics and/or non-steroidal anti-inflammatory drugs) was followed by all patients having developed headache (n = 45). EBP was only considered as a therapeutic option in case of persistent headache due to failure of conservative treatment and was followed by 32.8% (19/58) of the patients, with an 84.2% success rate regarding relief of symptoms. This was carried out in most patients up to 48 hours upon symptom onset (89.5%) and consisted of a slow perfusion of autologous blood in the epidural space, up to a 20 ml volume. A second EBP was needed in 15.8% (3/19) of the patients. An average 4.83 days (2-11 days, 95% CI) length of stay was found.

Table 2 - ADP-related technique characteristics (n = 58)

		ADP n (%)
Procedure	Epidural	52 (89.7)
	CSE	6 (10.3)
Patient positioning	Sitting	18 (31.1)
	Left lateral decubitus	40 (69.9)
Initial lumbar interspace	L2-L3	5 (8.6)
	L3-L4	48 (82,8)
	L4-L5	5 (8.6)
CSF leak origin	Epidural needle	34 (58.6)
	Catheter	8 (13.8)
	Undetermined	16 (27.6)

n: number of patients; CSE: combined spinal-epidural technique; CSF: cerebrospinal fluid; ADP: accidental dural puncture.

Table 3 - Management of ADP

		Recognized and/or unrecognized ADP (n = 42 and/or 4)
Lumbar epidural catheter	Same interspace	21 (50.0)
	Different interspace	9 (21.4)
Intra-thecal catheter placement		9 (21.4)
Abandoned loco-regional technique		3 (7.2)
Prophylactic measures		35/46 (76.1)

n: number of patients; ADP: accidental dural puncture.

Table 4 - ADP characteristics (risk factors and treatment)

PDPH				*p*
n			45/58 (77.6)	
Intensity	Mild		5 (11.1)	
	Moderate		36 (80.0)	
	Severe		4 (8.9)	
Onset	< 24h		16 (35.5)	
	24 - 48h		23 (51.1)	
	48 - 72h		3 (6.7)	
	> 72h		3 (6.7)	
Associated symptoms			20/45 (44.4)	
Conservative treatment			45 (100)	
Procedure	Epidural *vs.* CSE		39 (75.0) *vs.* 6 (100)	> 0.05
Patient positioning	Left lateral decubitus *vs.* Sitting		31 (77.5) *vs.* 14 (77.8)	> 0.05
Catheter site	Epidural *vs.* Intra-thecal		37 (82.2) *vs.* 5 (55.6)	> 0.05
Type of birth	Vaginal *vs.* Caesarean section		28 (73.7) *vs.* 17 (85.0)	> 0.05
Prophylactic measures prescription *vs.* non-prescription			25 (71.4) *vs.* 11 (72.7)	> 0.05
Therapeutic EBP	Yes		19/58 (32.8)	
	Timing	24 - 48h	2 (10.5)	
		48 - 72h	4 (21.1)	
		> 72h	13 (68.4)	
	Repeat EBP		3/19 (15.8)	

n: number of patients; CSE: combined spinal-epidural technique; PDPH: post-dural puncture headache; EBP: epidural blood patch.

DISCUSSION

An ADP incidence between 0 and 2.6% was found in pregnant mothers who underwent epidural anaesthesia,[4,5] while an incidence rate below 1% was described in the UK.[1,6] The obstetric population is considered at increased risk for the development of PDPH. In 70 to 80% of the patients, symptoms related with CSF low-pressure were described upon ADP performed with a 16-gauge Tuohy needle.[1,7] Even though the use of 18-gauge needles usually reduce headache's severity, a similar incidence was found when using 16-gauge and 18-gauge needles (70-88% *vs.* 64%).[2] Spinal analgesia/anaesthesia involved a lower incidence rate of headache, below 0.5%, explained by the use of small 27-gauge pencil-point needles. A 0.3% global incidence rate of ADP and 77.6% rate of PDPH associated to epidural or CSE analgesia/anaesthesia were found in our study, in line with literature.

Whenever an ADP is recognized, different attitudes may be followed, namely re-siting the epidural catheter in the same or in a different lumbar interspace, re-siting in intra-thecal space or abandoning the regional technique and opting, for instance, for systemic analgesia. In line with our study, re-siting the epidural catheter in a different lumbar interspace was the most frequently described practice in a survey involving 160 North-American anaesthetists.[8] Even though intra-thecal catheter (ITC) placement has increased over the years, re-siting the epidural catheter into an adjacent lumbar interspace remains as the preferred option upon ADP.[9,10]

A variable rate of ITC placement upon ADP has been found and rates of 28, 18.5 and 35% have been described in studies carried out in the UK, the USA and in Australia, respectively.[9,11,12] In 2011, a survey involving North-American anaesthetists found a lower rate of just 6%.[8] The use of ITCs has been associated to a lower PDPH frequency.[12-14] A ten-year revision carried out in an Obstetrics Anaesthesiology Department summarised the conclusions obtained by different studies and found a 51% incidence rate of headache when ITC was placed and 66% when epidural catheter was placed, with 33 and 59% incidence rates of EBP use, respectively.[15] Despite these conclusions in favour of the use of ITC placement, this revision involved prospective and retrospective data and many of the studies were non-randomized nor did have enough power. In another study, the authors used and kept an ITC for 24 hours upon ADP. In this study's obstetric population, leaving the catheter in the sub-arachnoid space led to headache in just 6.2% of the patients, with an expected incidence rate over 50%.[13] However, a reduction in the incidence of headache when an ITC was left in place for under 24

hours was not described. A reaction to the catheter itself, with the presence of inflammation or oedema, preventing from any additional CSF leak upon removal of the catheter was suggested as the mechanism associated to the benefit of keeping the catheter in the subarachnoid space.[10] More recently, in 2012, converting to subarachnoid analgesia upon ADP did not lower the incidence rate of headache nor the need for the use of EBP, even though it was associated to faster neuroaxial analgesia.[16] An ITC was placed in 21.4% of our patients, although no significant difference was found regarding the incidence of headache when ITC placement was compared with re-siting in the epidural space (55.6 *vs.* 82.2, $p > 0.05$). Therefore, the decision for ITC placement must be carefully considered as, apart from the advantage of a quick and efficient subarachnoid anaesthesia, as well as preventing from another ADP, there is the disadvantage associated to its accidental use or infection.[10]

Different risk factors are associated to the development of PDPH. The selection of the technique as well as the type and size of the needle for lumbar puncture by the anaesthetist has an important role in the reduction of the incidence rate of PDPH.[2,17] In our study, we were not able to reach any accurate conclusion regarding the incidence of headache when comparing epidural with the CSE technique (75.0% *vs.* 100%, $p > 0.05$) due to the presence of a previous ADP with the Tuohy needle in patients who underwent the CSE technique (confounding factor). Due to the fact that the same type and size of needle was used in both techniques (18G Tuohy), we were not able to reach any conclusion regarding the type of needle used in ADP.

Different details related with the procedure does not seem to have any influence on the incidence rate of headache, including patient positioning.[10] No significant differences were found between left lateral decubitus and sitting position (77.5% *vs.* 77.8%, $p > 0.05$) as regards the incidence of headache.

A recent review found a lower rate of headache in patients having had a caesarean section *vs.* those having had a vaginal birth.[17] A headache incidence rate of approximately 11% was found in patients having had a caesarean section, when compared to over 75% in those having had a vaginal birth; in one study, a correlation between pushing stage (second stage) of labour and the development of headache was found.[18,19] In another study, higher headache incidence rate (80%) was found with vaginal when compared to caesarean section birth (15%), suggesting that Valsalva manoeuvre during the second stage of labour may increase dural tear upon puncture with a Tuohy needle.[20] However, additional studies are required in order to support this hypothesis, as any association between pushing stage of labour and an increased incidence rate of headache was found in other studies.[7,21] No significant differences were found in our study regarding the incidence of PDPH and the type of birth (vaginal or caesarean section) (73.7% *vs.* 85.0%, $p > 0.05$).

Prophylactic measures upon ADP aimed to reduce the development of headache are still carried out by physicians, despite little evidence of efficacy.[8] Between 62 and 93% of the patients were prescribed prophylactic oral hydration and a 75% rate was found in 2011.[7,8,9,11,22] Between 14 and 56% of the patients were recommended prophylactic bed rest and between 16 and 58% were recommended having caffeine drinks.[7,8,9,11,22] Even though none of these measures has shown any efficacy, recent studies with obstetric[8] and non-obstetric patients[9] showed that oral or intravenous aggressive hydration is recommended by 74 to 89%, bed rest by 48 to 56% and opioid and non-opioid drugs by 47 to 58% of physicians.[23,24] Prophylactic therapy with oral or intravenous caffeine proved to be effective in a small randomized study, with an absolute 27% reduction in headache incidence rate.[25] However, two meta-analyses proved that this therapy is ineffective.[24,26] A recent meta-analysis reached the conclusion that previous studies were not randomized and had not enough power; small series showing a benefit with abovementioned techniques had no control group and heterogeneous results mean that no technique can be recommended as effective.[24] In our study, 76.1% of the patients in whom an ADP had occurred were prescribed prophylactic measures (bed rest, forced hydration, caffeine drinks, analgesics and/or non-steroidal anti-inflammatory drugs) and no significant differences were found regarding the incidence rate of headache when comparing the patients having been prescribed prophylactic measures *vs.* those not having been prescribed such measures (71.4% *vs.* 72.7%, $p > 0.05$).

Conservative treatment and/or the use of an epidural autologous blood patch is recommended as first-line approach to PDPH. Conservative measures are similar to prophylactic, namely the use of forced oral and/or intravenous hydration, oral or intravenous administration of caffeine, bed rest and the use of analgesics, non-steroidal anti-inflammatory drugs and/or opioids. Between 86 and 93% of the patients were prescribed forced hydration,[8,9,11,22] even though some authors do not recommend it.[27,28] Between 32 and 85% of the patients were recommended caffeine drinks[8,9,11,22] and this is not consensual as a systematic review has found that the use of caffeine is not an effective approach to PDPH[29] and, more recently, a case-control study found that intravenous caffeine may be effective reducing the rate and severity of headache.[30] Between 14 and 71% of the patients were recommended bed rest[8,9,11,22] and absolute rest is not necessary for symptom relief.[31,32]

The use of EBP is recommended whenever headache persist beyond 48 hours[28] which has proven more effective than conservative measures.[33] Initially, EBP was associated to success rates of approximately 98%. Subsequent studies have described complete symptom relief in 75% of the patients, partial in 18% and failure in 7% and a delay in EBP less than 4 days was associated to poorer outcome.[34] CSF displacement from lumbar thecal sac due to increased epidural pressure and subsequent increased intracranial pressure is the mechanism associated to symptom relief upon EBP.[2] In our study, 32.8% of the patients underwent an EBP only upon conservative treatment failure and was

mostly (89.5%) used beyond 48 hours upon symptom onset, with an 84.2% success rate. A second EBP was needed in 15.8% (3/19) of the patients, with complete symptom relief. Global average length of stay was 4.83 days, higher to the average length usually found in an uncomplicated delivery.

The fact that it was a retrospective study with different uncontrolled variables, such as the fact that analgesia/anaesthesia technique has been carried out by different anaesthetists and the small size of our group of patients should be mentioned as limitations to the study. The identification of ADP/PDPH depends on the event being recorded by anaesthetists, reason why the identification of every patient may not be ensured. We were not able to find out whether the incidence and intensity of PDPH vary with the type of selected needle, as only 18-gauge Tuohy needles were used. The fact that one patient underwent an accidental puncture using an 18-gauge Tuohy needle and another intentional puncture using a pencil-point 27-gauge needle was identified as a confounding factor in the subgroup of patients who underwent the CSE technique (6/58). This subgroup of patients underwent the CSE technique (needle-through-needle technique) upon ADP with 18-gauge Tuohy needle and therefore the real incidence rate of headache with both techniques cannot be compared.

CONCLUSIONS

The incidence rate of ADP and PDPH was in line with what has been described in literature.

The incidence rate of headache was not related with patient positioning or with the type of birth. The insertion of a subarachnoid catheter did not prevent the development of headache, even though the catheter was not kept in place beyond 24 hours.

Upon ADP, re-siting of the epidural catheter in an adjacent lumbar interspace remains as gold standard and the implementation of prophylactic measures remains as a frequent practice, despite little evidence of efficacy. EBP is currently the gold standard treatment for PDPH, even though it was only used in our population upon conservative treatment failure and leading to a high success rate.

In short, further Portuguese studies aimed to assess the incidence as well as the approach to this complication of neuroaxial anaesthesia would be extremely relevant.

HUMAN AND ANIMAL PROTECTION

The authors declare that the followed procedures were according to regulations established by the Ethics and Clinical Research Committee and according to the Helsinki Declaration of the World Medical Association.

DATA CONFIDENTIALITY

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest in writing this manuscript.

FINANCIAL SUPPORT

The authors declare that there was no financial support in writing this manuscript.

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