

# Increasing the labour epidural rate in a state hospital in South Africa: challenges and opportunities

Stephanus F van Zyl\* and Jonathan L Burke

Department of Anaesthesiology and Critical Care, Stellenbosch University and Tygerberg Hospital, Cape Town, South Africa

\*Corresponding author, email: [stephanvanz@gmail.com](mailto:stephanvanz@gmail.com)



**Background:** A 2012 audit on labour epidural analgesia rates in Tygerberg Hospital (TBH) revealed that only 2.2% of labouring parturients received epidural analgesia. This unacceptably low number necessitated a dedicated epidural service that was subsequently initiated in June 2014 by the Department of Anaesthesiology and Critical Care to improve the quality of care in labouring patients.

**Methods:** A retrospective follow-up audit was conducted from June 2014 to December 2015 and included data on epidural rates, indications, complications and patient satisfaction. Comparison was made with the 2012 data to evaluate the impact of change on care provided and to recommend future changes.

**Results:** Labour epidural rates improved to 5.16% for the audit period, with 2014 and 2015 rates of 7.44% and 3.89% respectively. Daytime epidurals doubled in 2014/2015 and complication rates decreased from 32.3% in 2012 to 16%. Primary indications for epidural analgesia included pre-eclampsia, morbid obesity, primigravidity and cardiac conditions. Although 99.8% of the complications were minor and transient, one fatality was reported during the audit period. This mortality emphasises the importance of team training in every aspect of epidural analgesia, so that the desired increase in epidural rate is associated with safe practice.

**Conclusions:** An important increase in epidural rates as well as a decrease in minor complications was observed. The fatality indicates that the expansion of the service should be accompanied by in-depth training of the entire team, so that the process becomes routine and complications are reduced. A fatal drug error, a 'never event', should not occur.

**Keywords:** analgesia, audit, complications, epidural, labour

## Introduction

Labour epidural rates have increased to more than 50% in larger centres in the USA<sup>1,2</sup> and even approach 70–80% in other developed countries.<sup>3</sup> Epidural analgesia results in lower pain scores and increased maternal satisfaction and therefore has been identified as the gold standard for intrapartum pain relief when compared with other analgesic modalities such as nitrous oxide and systemic opioids.<sup>4–7</sup> During an audit in 2012<sup>8</sup> it was reported that only 2.2% of labouring parturients received epidural analgesia at Tygerberg Hospital (TBH). The cause of this very low rate compared with first world countries was multifactorial, and the need for improvement was undeniable. TBH is a high-risk obstetrics centre, where a large population of patients present with pregnancy-related comorbidities such as pre-eclampsia and obesity. The annual Caesarean section rate is 45% of all deliveries and more than 85% of these are emergencies.

Prior to 2014, a single anaesthesiology registrar on the labour ward service was responsible for all obstetric and gynaecological emergencies and could not attend to patients needing analgesia during labour. It became evident that the epidural rate in our high-risk setting is not comparable to that in developed countries. Many of these centres have low Caesarean section rates with low-risk obstetric patients that are well educated on labour analgesia options and have round-the-clock anaesthesiologists that can provide epidural analgesia on request. Post-epidural care as well as epidural rate adjustments are then provided by trained labour ward staff, a resource that is not always available at TBH.

Since 2014, the focus at TBH has been to improve epidural rates while simultaneously placing emphasis on patient safety, improving outcomes in our high-risk patient population and patient satisfaction. Literature on labour epidural rates in developing countries is limited, but the situation at TBH could be comparable to that described in a study from the Shijiazhuang Gynecological and Obstetric Hospital in Beijing.<sup>9</sup> Epidural rates increased from 0% to 59% over a two-year period after a dedicated epidural service was initiated, and the Caesarean section rate decreased from 47% to 30%.

In TBH, two significant changes were made in 2014 by the Department of Anaesthesiology and Critical Care to improve obstetric services. First, a dedicated list for elective Caesarean sections was made available 2½ days per week, and emergency gynaecological procedures would be managed in the general emergency theatre. Second, a dedicated epidural service was initiated in June 2014 and was provided by an anaesthesiology registrar on a four-week epidural rotation, for 45 h per week (Monday to Friday, 8:00 am to 5:00 pm). Duties of this registrar included providing epidural care and daily assistance in the Obstetrics Critical Care Unit (OCCU), as well as attendance at the weekly high-risk obstetrics clinic with the anaesthesiology consultant. A staff nurse trained in epidural care was available most of the time to assist the registrar during epidural catheter placement and to provide further epidural care, including administration of top-ups and adjustment of infusions.

Table 1: Comparison of data between the 2012 and 2014/2015 audits at TBH (2012 data retrieved from original audit<sup>6</sup>)

Variable	2012		2014 Jul-Dec		2015 Jan-Dec		Total audit	
	n	%	n	%	n	%	n	%
Deliveries	7 005		4 390		7 481		11 871	
Caesarean sections	3 032	43.3	2 073	47.2	3 465	46.3	5 538	46.7
Elective Caesarean sections			437		429		866	
Emergency Caesarean sections			1 636		3 036		4 672	
NVD			2 317		4 016		6 333	
Total assisted deliveries			109		130		239	
Records of epidural analgesia audit)	157	2.2	294	7.44	274	3.89	568	5.16
Total epidurals performed for labour analgesia (elective Caesarean section not included in follow-up)								
Epidural labour analgesia records retrieved for analysis	149	94.9	294	100	274	100	568	100
*Epidural records adequately completed (excluding follow-up)			278	94.6	247	90.1	525	92.4
Patient follow-up (next day)			258	87.8	242	88.3	500	88.0
Adequate	8	5.1	36	12.2	32	11.7	68	12.0
Inadequate								
Time of epidural	78	52.3	275	93.5	263	96.3	538	94.9
Dayshift								
Nightshift	69	46.3	19	6.5	10	3.7	29	5.1
Primary indications	54	36.2	119	40.5	144	52.7	263	46.4
Pre-eclampsia								
BMI > 45 kg.m <sup>-2</sup>	33	22.1	54	18.4	48	17.6	102	18
Cardiac condition	22	14.8	24	8.2	30	11	54	9.5
Augmentation of labour	11	7.4	15	5.1	5	1.8	20	3.5
Primigravidity	21	14	46	15.6	21	7.7	67	11.8
Lung disease	5	3.4	4	1.4	6	2.2	10	1.8
Other	8	5.4	30	10.2	17	6.2	47	8.3
Request	0	0	2	0.7	2	0.7	2	0.7
Anaesthesiologist experience	35	23.5	79	26.9	1	0.4	80	14.1
1st year								
2nd year	53	35.6	88	29.9	143	52.2	231	40.7
3rd year	33	22.1	120	40.8	73	26.6	193	34.0
4th year	27	18.1	3	1	47	17.2	50	8.8
Medical Officer	1	0.7	4	1.4	8	2.9	12	2.1
Consultant	0	0	0	0	2	0.7	2	0.4
Epidural technique	146	98	294	100	273	99.6	567	99.8
Midline approach								
Paramedian approach	3	2	0	0	1	0.4	1	0.2
Loss of resistance	105	71.4	220	74.8	269	98.2	489	86.1
Saline								
Air	42	28.6	74	25.2	4	1.5	8	13.7

(Continued)

Table 1: (Continued)

Variable	2012		2014 Jul-Dec		2015 Jan-Dec		Total audit		
	n	%	n	%	n	%	n	%	
Mode of delivery	Caesarean section	61	40.9	134	45.6	121	44.2	255	44.9
	Normal vertex delivery	76	51	141	48.0	148	54.0	289	50.9
	Mode not reported			19	6.5	5	1.8	24	4.2
	Assisted/instrumental vaginal delivery	12	8.1	20	6.8	20	7.3	40	7.3
Patient satisfaction	Unhappy	16	14	4	1.4	11	4.0	15	2.6
	Happy	57	50	117	39.8	98	35.8	215	37.9
	Very happy	41	36	149	50.7	138	50.4	287	50.5
	Unknown			24	8.2	27	9.9	51	9.0

**Methods**

An application to audit the data on the labour epidural service was submitted with a protocol (S16/01/11) to the Stellenbosch University Health Research Ethics Committee (HREC) and after protocol approval and data collection, data were analysed by the Centre for Statistical Consultation at Stellenbosch University.

All patients receiving an epidural for labour analgesia between July 1, 2014 and December 31, 2015 were included in the audit. Patients requiring epidurals were identified daily on ward rounds by the obstetrician on call or at the weekly anaesthetic high-risk clinic. Written informed consent was obtained from all parturients directly by the attending physician or with the help of a translator. Epidural records made provision for date and time of placement, physician experience, approach to the epidural space, level of injection, distance from the skin to epidural space, test dose given, loading dose given, epidural infusion rate and blood pressure recordings. Blood pressures were recorded every 5 min for the first half hour and then hourly up to 5 h as per protocol. Hypotension was defined as a reduction in systolic blood pressure (SBP) of more than 20% from baseline or an SBP of less than 90 mm Hg, measured non-invasively.

The record also made provision for patient follow-up. Date and time of follow-up, date and mode of delivery, complications and patient satisfaction were recorded in this section. Complications included hypotension, dural puncture, back pain and pruritus (Table 1). Language barriers necessitated introduction of the terminology 'unhappy', 'happy' or 'very happy' to evaluate patient satisfaction during the audit.

For accurate comparison, study variables were kept similar to the original audit in 2012. Study variables included: total number of deliveries, normal vertex and assisted delivery rates, Caesarean section rates, epidural numbers and rates, indications, complications and patient satisfaction. Epidural technique and anaesthesiologist experience were also documented. For data collection and analysis Microsoft Office Excel® 2010 (Microsoft Corp, Redmond, WA, USA) was used.

**Results**

The 19-month audit period included a total of 11 871 deliveries, but since the emphasis of the epidural service falls on labouring patients, elective Caesarean sections were excluded from the audit, leaving a sample size of 11 005 parturients. A total of 568 epidurals were performed at a rate of 5.16% for all parturients. In 2014 (June–December), 294 epidurals were performed in 3 953 labouring patients, and in 2015 the incidence was 274 of 7 052 labouring patients, or 7.44% and 3.89% respectively (Figure 1). In all, 525 (92.4%) of the epidural records were complete and 500 patients (88,0%) were followed up on the following day (Table 1). Often only one blood pressure was recorded after epidural catheter placement, since a number of patients were delivered in the operating room and blood pressures (BP) were thus recorded on a separate chart.

Caesarean section rates at TBH were not affected by epidural analgesia and remained similar to the general rate of 45% in 2014 and 2015 (Figure 2).<sup>10</sup> However, the incidence of assisted deliveries increased from 2.09% in the general parturient population to 6.8% (n = 20) in 2014 and from 1.73% to 7.3% (n = 20) in 2015 when an epidural was inserted.

The primary indication for epidurals was similar to the 2012 audit with pre-eclampsia accounting for 46.4% of all indications

(Figure 3). A BMI above 45 kg/m<sup>2</sup> accounted for 18% of all cases and cardiac diseases constituted 9.5%. Primigravidity was the only indication in 11.8% of cases. Of 568 (44.9%) patients receiving epidural care, 255 were primigravidae.

Most epidurals were performed by second-year registrars (40.7%) and the fewest by consultants. A midline approach was followed in 99.8% of cases and 86.1% used saline for loss of resistance. The mean distance from skin to the epidural space was 6.6 cm with a standard deviation of 1.6 cm. The catheter was advanced 5.1 ± 0.7 cm into the epidural space. Epidurals were performed at the L3/L4 interspace in 78% of cases and at L4/L5 in 15.5% of patients.

The most common complication was hypotension, with an overall rate of 6.9%. In 2015 this was the commonest complication (12.8%) (Table 2). Dural puncture was the most common complication in 2014, at 4.1%. Two patients developed post-dural puncture headache (PDPH). One fatality occurred after a 200 ml bag containing 0.1% bupivacaine and 500 µg fentanyl was connected in error to an intravenous line. The resuscitation attempt, including an intralipid infusion, was unsuccessful.

The percentage of patients being 'very happy' with the care increased from 36% in 2012 to 50.5% overall, and dissatisfaction rates decreased from 14% in 2012<sup>8</sup> to 2.6%. In 51 patients (9.0%) there were no records of patient satisfaction.

## Discussion

Epidural analgesia remains the gold standard for intrapartum pain relief worldwide.<sup>4-6</sup> In addition, at referral centres such as TBH, the early placement of an epidural catheter in high-risk cases such as pre-eclampsia, obesity and cardiac disease

facilitates rapid conversion to surgical anaesthesia for Caesarean delivery. This mode of analgesia was greatly under-utilised at TBH,<sup>8</sup> primarily due to resource constraints, and consequently many patients failed to receive the benefits. Initiating a dedicated epidural service at TBH influenced the labour epidural statistics in a number of ways. Epidural rates have increased to over 5%, and complication rates decreased from over 30% in 2012 to 16% in 2014/2015, which is in keeping with rates from centres in developed countries.<sup>11-13</sup> An increase in the proportion of daytime epidurals to more than 90% might be an important contributing factor to these statistics (Figure 4). In addition, fewer junior registrars were involved in procedures (23.5% in 2012 vs. 14.1% in 2014/2015). Dedicated staff also provided post-epidural care and complications could be detected and managed early (Figure 4).

A meta-analysis comparing epidural and combined spinal-epidural (CSE) reported an overall incidence of hypotension in 11.8% of women in the epidural group, from 14 different studies.<sup>14</sup> Although our audit indicated a hypotension rate of 6.9%, this complication appears to be under-reported, since noninvasive blood pressure recordings were inadequate in 12.3% of patients. It is not clear whether these measurements were interrupted due to transfer to the operating room, or whether this reflects sub-optimal epidural care. Nineteen inadvertent dural punctures (3.3%) occurred during our audit, of which only three developed PDPH. In a meta-analysis involving 30 000 obstetric patients, Choi *et al.* showed a 1.5% risk for dural puncture, and 52% subsequently developed PDPH.<sup>15,16</sup> To avoid under-reporting of complications, these statistics emphasise the importance of epidural care and thorough follow-up to identify and manage complications promptly.

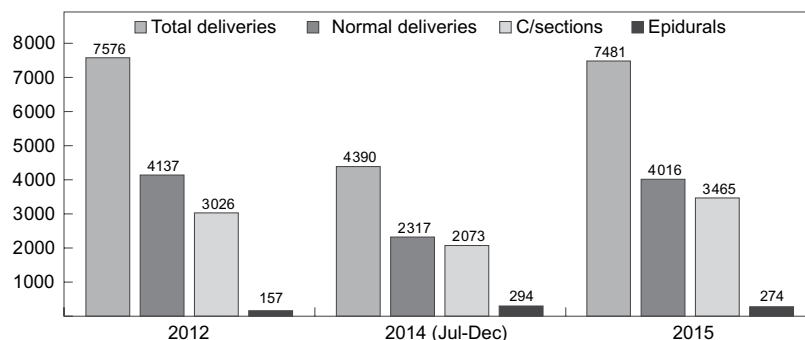


Figure 1: Comparison of total deliveries, mode of delivery and epidurals at TBH for 2012, 2014 (July–December) and 2015.

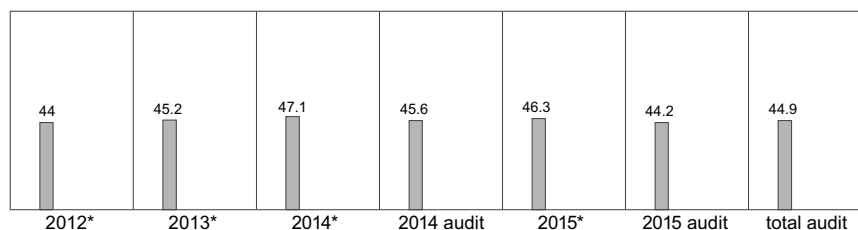


Figure 2: Caesarean section rates at TBH (2014 and 2015 audit refers to patients receiving epidural care whereas (\*) refers to the overall Caesarean section rates).

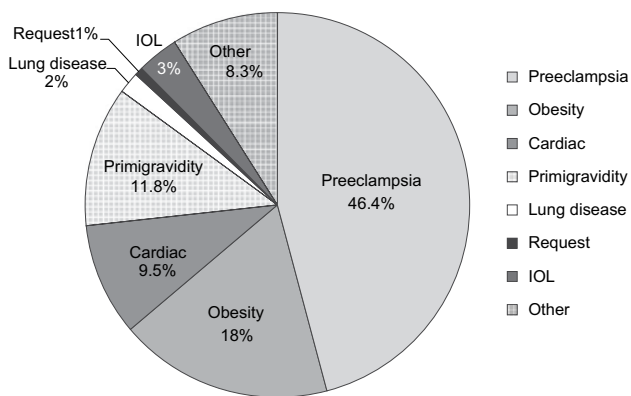


Figure 3: Indications for epidural analgesia at TBH. Note: \*IOL= induction of labour.

Table 2: Comparison of common epidural complications for 2012 and 2014/2015 audits

Complication	2012, % (n)	2014, % (n)	2015, % (n)	Total audit % (n)
Hypotension	13.4 (20)	1.4 (4)	12.8 (35)	6.9 (39)
Dural puncture	4 (6)	4.1 (12)	2.6 (7)	3.3 (19)
PDPH	3.4 (5)	0.7 (2)	0.4 (1)	0.5 (3)
Total spinal	n/a	0.3 (1)	0.4 (1)	0.4 (2)
Nausea and vomiting	2.7 (4)	0.7 (2)	1.1 (3)	0.9 (5)
Residual paraesthesia	0.7 (1)	0.3 (1)	1.1 (3)	0.7 (4)
L/A toxicity	n/a	0 (0)	0.7 (2)	0.4 (2)
Back pain	7.4 (11)	1.4 (4)	2.6 (7)	1.9 (11)
Pruritus	n/a	0.3 (1)	1.5 (4)	0.9 (5)
Total	32.3 (48)	9.2 (27)	23 (63)	15.8 (90)

Notes: PDPH = post-dural puncture headache, L/A = local anaesthetic.

Epidural failure rates were not accurately reported during the audit but only 15 (2.6%) of parturients receiving epidurals were dissatisfied with the analgesia. Since 9% of patients were lost to follow-up, the failure rate at TBH is probably comparable with the 8.4% incidence of inadequate analgesia in a retrospective study involving 12 590 neuraxial procedures.<sup>17</sup> Dissatisfaction rates decreased from 14% in 2012<sup>8</sup> to 2.6% in our sample population, which is in line with world standards.<sup>18-20</sup> The percentage of

patients being 'very happy' with the care increased from 36% in 2012 to 50.5%. These data reflect an overall improvement in epidural care.

The achievement of the high labour epidural rates of developed countries<sup>1,2</sup> is a challenge in the context of South African state hospitals. Patients with higher socio-economic status and level of education<sup>1,21</sup> had a significantly higher preference for an epidural during labour, and one study has shown that 'patient request' was one of the main factors that influenced the increase in labour epidural rates in the USA.<sup>22</sup> The small number of patients who requested labour analgesia in our audit reflects a lack of patient knowledge of labour analgesia options, which probably applies throughout South Africa. This was also shown in 2007 during a survey done at Cecilia Makiwane Hospital in the Eastern Cape.<sup>23</sup>

A conservative approach to epidural analgesia has in the past been adopted by the obstetrics team, due to concerns about the possibility of an increased incidence of assisted deliveries,<sup>5</sup> a prolonged second stage of labour (as was shown in retrospective studies<sup>24,25</sup>), and the incorrect belief that Caesarean section rates increased.<sup>11-13,26-30</sup> Further major limitations to expansion of the service at TBH have included constraints on anaesthetic and nursing human resources, and inadequate education of the nursing staff, which limits our epidural service to 45 h per week. In this context, it is our opinion that four epidurals per day would be safe and manageable. The ultimate goal should be to provide epidural analgesia to every high-risk parturient who is identified. This would translate into an overall epidural rate of approximately 13%. Great enthusiasm was shown during the first two months after expansion of the epidural service, and a total of 94 epidurals were performed, with rates approaching 10%. This shows that higher targets could be achieved should resources be improved.

With expansion of the epidural service, the main goals should include patient safety and satisfaction, and improved outcomes. To ensure a sustainable, efficient and safe epidural service, a formal nursing staff training programme is needed, where all team members are trained to an acceptable standard. This will create a critical mass of trained permanent nursing staff on the labour ward, in an environment where temporary locum staff currently make up a large proportion of the midwives. Such training would prevent 'never events' such as intravenous administration of local anaesthetic. Administration of top-up local anaesthetic doses should be performed only by an anaesthetist, in the interests of safety. Availability of dedicated epidural nursing staff would play a major contributory role to

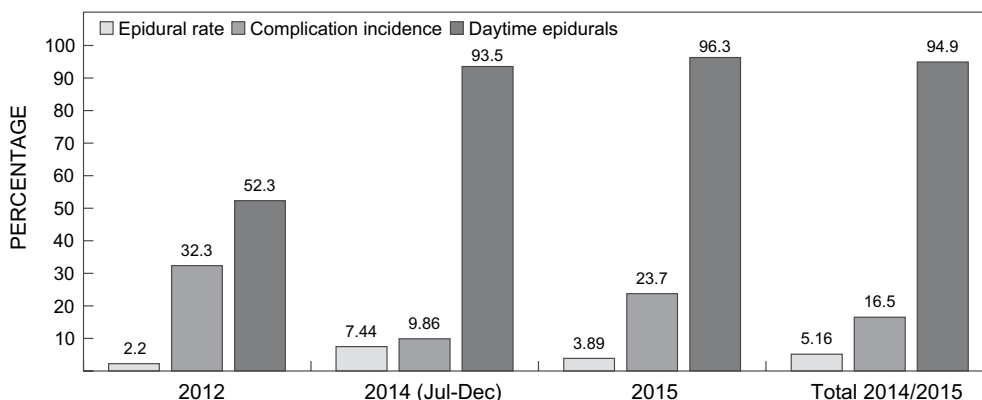


Figure 4: Comparison of epidural rates, complication rates and daytime epidurals between the 2012 and follow-up audits (values are percentages).



both the lowering of complication rates, and increasing epidural rates.<sup>21</sup> Knowledgeable staff are able to educate patients on the value of labour epidural analgesia and may even assist obstetric consultants in identifying those high-risk women who would benefit most from epidural care.<sup>31</sup>

## Conclusion

We have shown that it is possible to increase the rate of placement of labour epidural catheters in a busy referral state hospital such as TBH. Key factors that have been identified are human resource allocation, nursing staff training and patient education. Any attempt to further increase epidural rates should happen in parallel with thorough training of the entire labour ward team.

*Disclosure statement* – No potential conflict of interest was reported by the authors.

*Conflict of interest* – The authors declare that they have no financial or personal relationship(s) which may have inappropriately influenced them in writing this paper.

## References

- Osterman MJ, Martin JA. Epidural and spinal anesthesia use during labor: 27-state reporting area, 2008. *Natl Vital Stat Rep.* 2011;59(5):1–13, 16.
- Hawkins JL, Gibbs CP, Orleans M, et al. Obstetric anesthesia work force survey, 1981 versus 1992. *Anesthesiology* 1997;87: 135–43. <https://doi.org/10.1097/00000542-199707000-00018>
- Bucklin BA, Hawkins JL, Anderson JR, et al. Obstetric anesthesia workforce survey: twenty-year update. *Anesthesiology* 2005;103(3): 645–53. <https://doi.org/10.1097/00000542-200509000-00030>
- Cambic CR, Wong CA. Labour analgesia and obstetric outcomes. *Br J Anaesth.* 2010;105(Supplement 1): 50–60. <https://doi.org/10.1093/bja/aeq311>
- Anim-Somuah M, Smyth R, Howel C. Epidural versus non-epidural or no analgesia in labour. *Cochrane Database Syst Rev.* 2005;4:CD000331.
- Howell CJ, Chalmers I. A review of prospectively controlled comparisons of epidural with non-epidural forms of pain relief during labour. *Int J Obstet Anesth.* 1992;1(2): 93–110. [https://doi.org/10.1016/0959-289X\(92\)90008-R](https://doi.org/10.1016/0959-289X(92)90008-R)
- Wong CA. Advances in labor analgesia. *Int J Womens Health* 2009;1: 139–154. <https://doi.org/10.2147/IJWH>
- Jacobs-Martin GG, Burke JL, Levin AI, et al. Labour epidural analgesia audit in a tertiary state hospital in South Africa. *South African J of Anaesth Analg.* 2015;20: 174–8.
- Hu LQ, Yee L, Miller E, et al. No pain labor & delivery: a collaborative educational-global health initiative to transform current knowledge and skills into better maternal and neonatal outcomes. *Am J Obstet Gynecol.* 2014;210(1): S204–5. <https://doi.org/10.1016/j.ajog.2013.10.437>
- Annual reports 2012-2015 for the Department of Obstetrics and Gynaecology, Tygerberg Hospital, Western Cape, South Africa, Compiled by Prof GB Theron. (Unpublished data).
- Fogel ST, Shyken JM, Leighton BL, et al. Epidural labor analgesia and the incidence of Cesarean delivery for dystocia. *Anesth Analg.* 1998;87: 119–23.
- Gribble RK, Meier PR. Effect of epidural analgesia on the primary caesarean rate. *Obstet Gynecol.* 1991;78: 231–4.
- Johnson P, Rosenfield JA. The effect of epidural anesthesia on the length of labor. *Fam Pract.* 1995;12: 244–7. <https://doi.org/10.1093/fampra/12.2.244-a>
- Simmons SW, Cyna AM, Dennis AT, et al. Combined spinal-epidural versus epidural analgesia in labour. *Cochrane Database Syst Rev.* 2007;3:CD003401.
- Choi PT, Galinski SE, Takeuchi L, et al. Les céphalées post-ponction durale sont une complication courante du bloc neuraxial chez les parturientes: une méta-analyse d'études obstétricales. *Can J Anaesth.* 2003;50(5): 460–469. <https://doi.org/10.1007/BF03021057>
- Agarwal A, Kishore K. Complications and controversies of regional anesthesia: a review. *Indian J of Anaesth.* 2011;55(5): 543–53.
- Pan PH, Bogard TD, Owen MD. Incidence and characteristics of failures in obstetric neuraxial analgesia and anesthesia: a retrospective analysis of 19,259 deliveries. *Int J Obstet Anesth.* 2004;13(4): 227–33. <https://doi.org/10.1016/j.ijoa.2004.04.008>
- Leighton BL, Halpern SH. The effects of epidural analgesia on labor, maternal, and neonatal outcomes: a systematic review. *Am J Obstet Gynecol.* 2002;186(5): S69–77.
- Kemmerly JR, Lambard WW, Russell RC. Epidural anesthesia performed during labor by obstetricians: outcome analysis. *South Med J.* 1999 Nov;92(11): 1075–8. <https://doi.org/10.1097/00007611-199911000-00006>
- Fyneface-Ogan S, Mato CN, Anya SE. Epidural anesthesia: Views and outcomes of women in labor in a Nigerian hospital. *Ann Afr Med.* 2009;8(4): 250–6. <https://doi.org/10.4103/1596-3519.59580>
- Stark MA. Exploring women's preferences for labor epidural analgesia. *J Perinat Edu.* 2003;12(2): 16–21.
- Graninger EM, McCool WP. Nurse-midwives' use of and attitudes toward epidural analgesia. *J Midwifery Women's Health.* 1998;43(4):250–61.
- Mugambe JM, Nel M, Hiemstra LA, et al. Knowledge of an attitude towards pain relief during labour of women attending the antenatal clinic of Cecilia Makiwane Hospital, South Africa. *SA Fam Pract.* 2007;49(4): 16.
- Finster M, Santos AC. The effects of epidural analgesia on the course and outcome of labour. *Baillière's Clinical Obstetrics and Gynaecology* 1998;12(3): 473–83. [https://doi.org/10.1016/S0950-3552\(98\)80079-5](https://doi.org/10.1016/S0950-3552(98)80079-5)
- Lieberman E, O'Donoghue C. Unintended effects of epidural analgesia during labor: A systematic review. *Am J Obstet Gynecol.* 2002;186(5): 531–68. [https://doi.org/10.1016/S0002-9378\(02\)70181-6](https://doi.org/10.1016/S0002-9378(02)70181-6)
- Yancey MK, Pierce B, Schweitzer D, et al. Observations on labor epidural analgesia and operative delivery rates. *Am J Obstet Gynecol.* 1999;180: 353–9. [https://doi.org/10.1016/S0002-9378\(99\)70213-9](https://doi.org/10.1016/S0002-9378(99)70213-9)
- Lyon DS, Knuckles G, Whitaker E, et al. The effect of instituting an elective labor epidural program on the operative delivery rate. *Obstet Gynecol.* 1997;90(1): 135–41. [https://doi.org/10.1016/S0029-7844\(97\)00214-7](https://doi.org/10.1016/S0029-7844(97)00214-7)
- Socol ML, Garcia PM, Peaceman AM, et al. Reducing cesarean births at a primarily private university hospital. *Am J Obstet Gynecol.* 1993;168: 1748–58. [https://doi.org/10.1016/0002-9378\(93\)90686-D](https://doi.org/10.1016/0002-9378(93)90686-D)
- Howell CJ. Epidural versus non-epidural analgesia for pain relief in labour. *Cochrane Database Syst Rev.* 2000;3 (2):CD000331.
- Klein MC. Does epidural analgesia increase rate of cesarean section? *Can Fam Phys.* 2006;52(4): 419–421.
- Hodnett ED. Pain and women's satisfaction with the experience of childbirth: A systematic review. *Am J Obstet Gynecol.* 2002;186(5):S160–72.

Received: 06-05-2017 Accepted: 03-11-2017