



## Regional anaesthesia in obese patients – an update

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### Abstract

**Background and Purpose:** Obesity is a worldwide problem. The present article will summarise current opinions and evidences about the unique problems of performing regional anaesthesia in obese patients and the potential solution of these problems. The focus will be on technical and logistic difficulties attributed to the unpredicted anatomy of the obese body and appropriate adjustment of local anaesthetic dosage.

**Materials and Methods:** We performed a comprehensive research of the literature with key words: obesity, regional anaesthesia in Medline.

**Results:** Most reports and studies about performing regional anaesthesia in obese patients come from specific subpopulation of obstetric patients. Most reported difficulties in obese obstetric patients: complicated placement, failure to establish, insufficient duration of regional anaesthesia and longer intraoperative time. In addition obesity is associated with higher peripheral block failure (supraclavicular axillary brachial plexus). There is no clear consensus about local anaesthetic dosage adjustments in obese.

**Conclusions:** Nowadays, we are aware of potential difficulties and possible solutions. New technologies, particularly ultrasound, and new devices offer help in solving some technical problems.

### INTRODUCTION

Obesity is a worldwide healthcare problem. Its prevalence has been rising affecting almost every human organ system (e.g. cardiovascular, pulmonary, urinary and gastrointestinal, endocrine etc.) and causing chronic medical diseases (e.g. systemic hypertension, diabetes mellitus, obstructive sleep apnea syndrome, non alcoholic steatohepatitis etc.) In adults, the body mass index (defined as ratio of body weight in kilogram and squared body height in meter) has been used as the comparative measure to define overweight (BMI = 25–29 kg/m<sup>2</sup>), obese (BMI = 30–39 kg/m<sup>2</sup>) and morbidly obese (BMI ≥ 40 kg/m<sup>2</sup>). The World Health Organisation (WHO) figures about obesity prevalence best illustrate the pandemic nature of this disease. In 2010 highest prevalence of obese among 192 WHO Member States has been reported in Nauru (males 84.6%, females 80.5%) and the Cook Islands (males 72.1%, females 73.4%). There have been reported 44.2 % obese males and 48.3 % obese females in the United States in 2010. Table 1 and 2 show the prevalence of obese adults in the selected European countries according to WHO data (1).

**TABLE 1**

Prevalence of obese (BMI  $\geq 30$  kg/m<sup>2</sup>) males (15–100 years) in the selected European countries in 2010 (1).

Country	Prevalence of BMI $\geq 30$ kg/m <sup>2</sup> (%)	Rank within European region
Greece	30.3	1/52
Malta	28.1	2/52
United Kingdom	23.7	3/52
Germany	22.9	5/52
Croatia	20.2	7/52
Belarus	16.2	17/52
Hungary	15.8	19/52
Denmark	12.0	34/52
Tajikistan	3.6	52/52

**TABLE 2**

Prevalence of obese (BMI  $\geq 30$  kg/m<sup>2</sup>) females in the selected European countries in 2010 (1).

Country	Prevalence of BMI $\geq 30$ kg/m <sup>2</sup> (%)	Rank within European region
Malta	36.1	1/52
Turkey	32.5	2/52
Belarus	32.2	3/52
Greece	26.4	8/52
United Kingdom	26.3	9/52
Germany	22.1	19/52
Croatia	17.6	31/52
Denmark	8.3	51/52
France	7.6	52/52

Having in mind the high prevalence and incidence of obesity, there is greater chance nowadays to have an obese patient scheduled for any type of general surgery. Obese patients pose specific problems to anaesthesiologists including the decision about selecting the anaesthetic technique that carries the least risk for the patient. Regional anaesthesia offers the good alternative to avoid generic difficulties faced with general anaesthesia (e.g. difficult intubation, cardiopulmonary depression, post-operative nausea and vomiting etc.) in selected operative procedures. However, regional anaesthesia is generally believed to be associated with a great rate of unsuccessful blocks and for this reason anaesthesiologists often give preference to general anaesthesia.

There are two basic challenges that should be overcome to get successful block in obese patients: technical and logistic difficulties attributed to the unpredicted anatomy of the obese body and appropriate adjustment of local anaesthetic dosage. The present article will summarise current opinions and evidences about the unique problems of performing regional anaesthesia in obese patients and the potential solution of these problems.

## TECHNICAL DIFFICULTIES IN PERFORMING REGIONAL ANAESTHESIA IN OBESE PATIENTS

### Neuroaxial blocks

Most reports and studies about performing regional anaesthesia in obese patients come from specific sub-population of obstetric patients. In majority of these, especially earlier published articles, we can find that regional anaesthesia can be performed without major difficulties and complications. Horikowa *et al.* reported no significant differences in time for spinal tap and the incidence of hypotension between the obese and control group in 90 parturients (2). In retrospective analysis of 1,461 consecutive caesarean sections Schultzek *et al.* recommended spinal anaesthesia even for obese parturients without reported difficulties (3). Saravanakumar *et al.* also advocated a more liberalised use of regional techniques as means to further reduce anaesthesia-related maternal mortality in the obese population. Moreover, they recommended prophylactic placement of an epidural catheter when not contraindicated in labouring morbidly obese women (4).

However, we should be a little bit sceptic and aware of the following facts that go in favour to regional anaesthesia. In general the subpopulation of pregnant women is healthy except for having anatomic and physiological changes attributed to pregnancy. In addition, because of specificity of situation with two patients at risk, regional anaesthesia is preferred to general in any case and so obstetric anaesthesiologists are more experienced and skilled in regional anaesthetic techniques especially spinal anaesthesia, epidural anaesthesia and continuous spinal epidural techniques (5). All these may be reasons why these early reports favour in general regional anaesthesia.

In recent years, however, there are more and more reported cases (6, 7) and retrospective studies of difficult spinal/epidural anaesthesia in obese parturients too. This gives a real picture of the problem or we could say the »other story«. According to one study difficulty in performing neuraxial anaesthesia during labour was greater in obese patients ( $P=0.004$ ) (8). Another study also identified complicated placement (5.6% morbidly obese, 2.8% overweight and obese, and 0% normal-weight, respectively;  $P=.007$ ), failure to establish (2% morbidly obese, 0% overweight and obese, and 0% normal-weight, respectively;  $P=.047$ ), and insufficient duration (4% morbidly obese, 0% overweight and obese, and 0% normal-weight, respectively;  $P=.02$ ) of regional anaesthesia (9). One single-centre experience showed that choice of anaesthetic technique (CSE vs. spinal anaesthesia) varied according to obesity class. Total intraoperative time increased significantly with BMI ( $R=0.394$  kg/m<sup>2</sup>,  $P<0.001$ ). The highest anaesthesia-related costs during the study were generated by patients with BMI  $\geq 40$  kg/m<sup>2</sup>. The authors concluded that longer intraoperative periods must be considered in deciding upon the mode of anaesthesia for patients with BMI  $\geq 40$  kg/m<sup>2</sup> who undergo elective caesarean delivery (10). In addition, most re-

cently Rodrigues *et al.* showed that technical difficulties (difficulty to puncture and difficulty to palpate) as well as hypotension, bleeding, and surgical time were more frequent in pregnant patients with higher degrees of obesity (11).

The clinical value of this »other story« is offering possible solutions of overcoming difficulty problems. Apart from conversion to general anaesthesia (6), an extremely long epidural needle was advised to overcome the difficulties in epidural puncture (7). Some authors recommended not to use the iliac crest as the landmark (12) but in stead the method that is easily reproducible: by placing the hand diagonally on the pelvis, the depression of the anterior prominent point of the iliac crest is identified by the tip of the middle or index finger. A line is drawn from the point perpendicular to the spinal column and thus the area of skin is identified where the transverse process of L5 is projected (12, 13). Ultrasound can aid in performing neuroaxial block in locating the space (14, 15). Adachi *et al.* showed that the epidural space is deeper in obese patients (16). Balki *et al.* studied 46 obese parturients, with prepregnancy body mass index (BMI) >30 kg/m<sup>2</sup> (2), requesting labour epidural analgesia and found a strong correlation between the ultrasound-estimated distance to the epidural space and the actual measured needle distance in obese parturients. The authors suggested that prepuncture lumbar ultrasound might be a useful guide to facilitate the placement of epidural needles in obese parturients (17). Ultrasound can help even inexperienced residents (18). The combination of non-invasive mechanical ventilation with neuraxial anaesthesia may be of value in selected parturients with acute or chronic respiratory insufficiency requiring surgery (19).

### Peripheral nerve blocks

Contrary to neuroaxial blocks, the authors consistently, from early publications up to nowadays, report about different degree of failure of peripheral nerve blocks in obese patients. Nielsen *et al.* prospectively collected data including 9,038 blocks performed on 6,920 patients in a single ambulatory surgery centre. Their investigation showed that obesity was associated with higher block failure and complication rates in surgical regional anaesthesia in the ambulatory setting. Nonetheless, the rate of successful blocks and overall satisfaction remained high in patients with increased BMI. Therefore, the authors concluded that overweight and obese patients should not be excluded from regional anaesthesia procedures in the ambulatory setting (20). Franco *et al.* showed the overall success rate of 2020 supraclavicular blocks to be 97.3% in nonobese and 94.3% in obese patients ( $P < 0.01$ ). Residents completed 80% of the blocks in nonobese patients and 73% in obese patients ( $P < 0.01$ ) (21). According to Hanouz *et al.* obesity increased the failure rate and immediate complications of axillary brachial plexus block. The success rate was 97% overall, 91% in the obese and 98% in the non-obese patients ( $P = 0.003$ ). Additional nerve blocks at the elbow were performed more frequently in obese (7%) than in non-obese patients (2%;  $P = 0.007$ ). Acute complications (mainly vas-

cular puncture) were more frequent in obese than in non-obese patients (27% vs 9%;  $P < 0.001$ ). Patient satisfaction was 87% in the obese and 94% in the non-obese patients ( $P = 0.03$ ) (22).

Similar to neuroaxial block, ultrasound can help in performance of peripheral nerve block in obese patients too. Portable ultrasound provides efficient depiction of the interscalene plexus structures in obese patients and, when used for guidance of regional blockade, renders similar results as in patients of normal weight (23). Hayashi *et al.* reported successful performance of sciatic nerve block and continuous femoral nerve block under ultrasound for a 60-year-old morbidly obese woman (150 cm, 112 kg, BMI 49.8) who underwent total knee replacement (24).

However, ultrasound is not a miracle aid. Rauch *et al.* compared fluoroscope-guided and ultrasound – guided performance of lumbar medial branch block. Their success rate was 62% (52/84 blocks) when using ultrasound to guide needle placement. So they concluded that medial branch blocks in obese patients cannot be performed by ultrasound guidance exclusively (25). Additional limitations of clear visibility have been implied in performing sciatic nerve block (26). Saranteas pointed that in obese patients, because of deep anatomic location of nerves, the ultrasound beam travels longer, resulting in beam attenuation. According to the same author the image quality may be improved by using different technical approaches and advances ultrasound imaging techniques including 3D US (27).

### DRUG DOSAGE ADJUSTMENT IN PERFORMING REGIONAL ANAESTHESIA IN OBESE PATIENTS

Obese patients have normally smaller cerebrospinal fluid volumes and the reduced epidural space resulting in higher spread of local anaesthetics (14). There is the wide variability in dosage and sensitivity to spinal anaesthetics especially if comorbidity such as pre-eclampsia coexists (28). Many authors recommend the low dose and the low concentration of local anaesthetic for neuroaxial block in obese patient (12). The other did not find evidence for different doses of hyperbaric bupivacaine if single shot spinal anaesthesia is used for caesarean delivery in obese or normal weight patients, obese and normal weight patients (29).

### CONCLUSION

Regional anaesthesia is slowly establishing its credibility in all fields of its possible application. Due to the growing body of information on performing regional anaesthesia in obese and even morbidly obese patients, nowadays we are aware of its possible difficulties and complications. In addition, we are aware of possible solutions to overcome these problems. New technologies, particularly ultrasound, and new devices offer help in solving some technical problems. However, only active

approach and regular performance of blocks can improve our skills and change perspectives of our clinical practice.

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