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Masterthesis

Locoregional anaesthesia as the principal technique for oncological breast surgery: a case series

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Abstract

Oncological breast surgery is usually performed under general anaesthesia and surgical interventions with locoregional blocks as the sole anaesthetic agent are rarely performed. We present a retrospective observational case series of 15 patients who underwent breast surgery under locoregional anaesthesia with perioperative sedation. Locoregional anaesthesia consisted of thoracic paravertebral or erector spinae blocks, combined with a pectoral nerve (PECS-2) block. Sedation was achieved with intravenous ketamine and midazolam. Thirteen cases were successful, two patients needed conversion to general anaesthesia. We conclude this is a feasible alternative anaesthetic approach for breast surgery in selected cases.

Introduction

Breast cancer is the most common cancer worldwide in women, with around 2.3 million new cases per year[1]. Most of these patients require surgery via lumpectomy/quadrantectomy or mastectomy, with or without axillary lymphadenectomy. This surgery is most frequently carried out under general anaesthesia (GA) and may be supplemented by regional anaesthesia (RA) for postoperative analgesia[2]. GA can pose significant challenges or may even be contraindicated in the frail or high-risk patient with advanced comorbidities such as cardiorespiratory disease or a very difficult airway[2]. Patient refusal of GA is another indication for using RA. Regional blocks include among others the pectoral nerve block, the thoracic paravertebral and the erector spinae block. There is a growing interest in performing this surgery under regional anaesthesia alone as it maintains cardiovascular stability and avoids the risks associated with general anaesthesia, as demonstrated by results from some large international groups. To our knowledge, very few Belgian hospitals have experience with this approach. We therefore present in this case series our perioperative experience of 15 surgical breast interventions performed under locoregional anaesthesia with perioperative sedation.

Methods

Ethical approval for this study was provided by the ethical committee (Chairperson: Dr S. Gysenbergs, Erk. 689) of the Imeldaziekenhuis in Bonheiden, Belgium, on May 19th, 2023. The "Strengthening the Reporting of Observational studies in Epidemiology" (STROBE) guidelines were followed in reporting this study. For this retrospective, single-centre study, a departmental database was analysed. This database consisted of 15 patients who underwent elective breast surgery under regional anaesthesia with sedation between 2019 and May 2023. Registered data included: patient demographics (age, weight, length, American Society of Anaesthesiologists physical status classification), type of surgical intervention, comorbidities, type of locoregional block, local anaesthetic agent type and total volume administered, type and amount of perioperative

sedation, maximal Numeric Rating Scale (NRS) pain scores in recovery room, and type and volume of analgesia administered postoperatively. Inclusion criteria were age >18 years and elective breast surgery under locoregional anaesthesia. The only exclusion criterion was incomplete data registration.

Patients were seen at the preoperative anaesthesia consultation to discuss anaesthetic options. If locoregional anaesthesia as the sole technique was clinically indicated, patients were provided with detailed information about the technique. Indications for the surgery included very frail or high-risk patients with advanced comorbidities such as cardiorespiratory disease or a difficult airway where a general anaesthesia included a very high risk for the patient's safety. The possibility of conversion to general anaesthesia in case of block failure was discussed. Informed consent was obtained in each case.

On the day of surgery, all blocks were performed preoperatively under aseptic conditions on awake patients, with routine monitoring and secured IV access. No standard sedation was administered unless requested by the patient or at the discretion of the attending anaesthesiologist. An ultrasound-guided multi-injection thoracic paravertebral block (TPVB) or erector spinae block (ESB), followed by a PECS-2 block (recently redefined as the interpectoral-pectoserratus plane block) was performed. The choice between a TPVB or an ESB was based on the initial ultrasound scan and perceived sonoanatomy. The maximal injectable volume of ropivacaine was calculated prior to block placement, using a maximum dose of 2.5 mg/ kg. All blocks were performed by the same anaesthesiologist, who had substantial experience in ultrasound-guided locoregional anaesthesia.

Thoracic paravertebral block

The patient was positioned in the lateral decubitus or prone position. A parasagittal multilevel in-plane approach was used to visualize the transverse process, rib, costotransverse ligament and the parietal pleura as hyperechoic structures. Two thoracic T-levels were targeted (T2-T3 and T4-T5 or T3-T4 and T5-T6) under US guidance with a Sonoplex Stim 22 gauge 50 or 80 mm Pajunk-needle (Pajunk GmbH Medizintechnologie, Geisingen, Germany). The hypoechoic wedge-shaped paravertebral space was targeted in-plane after anaesthetizing the skin and puncture area with lidocaine 1%, 2 mL. Saline was used for hydrolocation of the needle tip and to observe pleural displacement. After negative aspiration, the pre-block determined volume of ropivacaine 0.375% was injected.

Erector spinae block

With the patient in the lateral decubitus or prone position, a sagittal in-plane approach was used to target the space between the thoracic transverse process and the m. erector spinae at the T5 intercostal level with a 22 gauge 50 or 80 mm Pajunk-needle. After negative aspiration, 20 mL of ropivacaine 0.375% was administered.

PECS-2 block

With the patient in the supine position and using an in-plane US guided approach and a 50 or 80 mm Pajunk-needle, ropivacaine 0.375% was administered between the m. pectoralis major and minor (max 10 mL) and between the m. serratus anterior and pectoralis minor (10-20 mL).

After an obligatory waiting period for the block to settle of 30 minutes and testing of dermatomes with ether and pinprick, patients were transferred to the operating room. Oxygen was administered via facemask with end tidal CO_2 monitoring. Patients received preincision intravenous (IV) titrated ketamine boluses of 10 mg and midazolam boluses of 1 mg. All patients received IV paracetamol during surgery.

Patients were monitored before and throughout surgery for signs of pain and distress. If necessary, a conversion to general anaesthesia was performed. Sedation was monitored clinically, no bispectral (BIS) indices were registered since at that time of the study, the department was in the acquisition phase of BIS monitors.

Patients were transferred to the recovery ward after the procedure. Pain scores were monitored with the 11-point numeric rating scale (0 = no pain, 10 = worst pain imaginable) by the nursing staff in the recovery room and the ward at fixed intervals and additional pain administration (piritramide IV) was registered.

We analysed the data using R (4.4.0) and are reported as mean with standard deviation, number or percentage, depending on the underlying distribution.

Results

Fifteen patients were included in this case series. Patient characteristic data can be found in Table I. The locoregional pathway was indicated because patients were considered unfit for general anaesthesia due to age and/or comorbidities, or at their own request. Comorbidities included pulmonary hypertension, hemodialysis, chronic cardiac failure, GOLD 4 chronic obstructive pulmonary disease. Six patients had a mastectomy, with or without axillary node resection, 8 subjects

Table I. — Patient characteristics, surgical procedures.

Age (y)	83.7 ± 7.7
Height (cm)	159.4 ± 7.2
Weight (kg)	72.6 ± 20.0
BMI (kg/m²)	28.6 ± 7.8
ASA physical status	3.0 ± 0.6
2 (n) (%)	1 (7)
3 (n) (%)	10 (71,5)
4 (n) (%)	3 (21,5)
Type of surgery	
Axillary tumor resection (n) (%)	1 (6.5)
Mastectomy (n) (%)	4 (26.5)
Mastectomy + axillary node resection (n) (%)	2 (13.5)
Wide excision + sentinel node biopsy (n) (%)	6 (40)
Wide excision (n) (%)	2 (13.5)
ASA: American Society of Anesthesiologists; BMI: Body Mass Index; All units mean ± SD.	

had a wide excision with or without sentinel node, 1 patient had a resection of a large axillary tumor. Twelve subjects had a TPVB plus PECS-2 block, two had an erector spinae block plus PECS-2 block, one had a PECS-2 block solely[3]. The technique was successful in 13 patients, two patients needed conversion to GA, both before the start of the surgery. In one case the block was deemed technically impossible because the essential anatomical structures were lying very deep and could not be visualized (BMI 47). In the second case a single injection paravertebral block was attempted (all other patients received multilevel TPVB) and the block was deemed unsatisfactory before surgery. One patient experienced a period of vagal syncope during block placement. The average dose/patient of ropivacaine was 132 mg with an average of around 2 mg/unit of body weight. Pre-incision sedation was administered in 12/13 patients (ketamine n=12, midazolam n=9). One patient received no sedation at all. The sedation was rated as 'oriented' and 'drowsy' in 7 and 6 patients respectively. Four patients needed extra ketamine post incision because of moderate pain. In all four cases this happened when the surgeon was dissecting deep in the axilla. No ketamine-related side effects

such as hallucinations or other complications were reported. Although this was not properly recorded, the surgeons were mostly very satisfied with the surgical conditions. The total doses of ropivacaine, ketamine and midazolam, maximal NRS scores and administered additional pain medication in the recovery room can be found in Table II. The average maximal NRS score in the recovery room was 2, the average amount of supplementary IV piritramide was 1 mg.

Discussion

This retrospective study shows it is possible to perform oncological breast surgery using locoregional anaesthesia as the principal technique plus moderate sedation in selected patients. The majority of our patients experienced excellent perioperative anaesthesia and postoperative analgesia with very low need for additional opioid pain killers. Possible advantages of this approach include the lack of intubation need, the reduction of perioperative morbidity through minimization of associated cardiopulmonary effects, postoperative nausea, vomiting and the use of opioids, and lower cost4[3]. Disadvantages include the risks associated with the used locoregional

Table II. — Medication, NRS score.

Total dose of ropivacaine; mg	132.5 ± 24.6
Total dose of intraoperative ketamine IV; mg	26.5 ±10.3
Total dose of intraoperative midazolam IV; mg	2.1 ± 1.9
Maximal NRS score recovery room	2.1 ± 1.7
Total dose of piritramide IV recovery room; mg	1.2 ± 1.9
NRS: Numeric Rating Scale; All units mean ± SD.	

blocks such as locoregional anaesthetic systemic toxicity, infection, pneumothorax and block failure.

Our findings are in line with the existing literature. Pawa et al. conducted a prospective observational case series of 16 breast cancer surgeries performed under thoracic paravertebral plus pectoral nerve block with propofol sedation[5]. They investigated feasibility of technique, patient acceptability and surgeon satisfaction. Fifteen out of 16 cases were successfully completed under sedation and regional anaesthesia. One patient needed conversion to general anaesthesia. Eleven out of 16 cases required low-dose intra-operative opioid analgesia. All patients experienced either no or minimal intra-operative pain and would choose this anaesthetic technique again. Surgeon-reported operating conditions were 'indistinguishable from general anaesthesia' in most cases, and surgeons were 'extremely satisfied' or 'satisfied' with the technique. Santonastaso et al. demonstrated that one can perform quadrantectomy with or without lymphadenectomy or lumpectomy (n,50) with a TPVB[6]. His group reported similar results in radical mastectomies (n,14) and in both studies no opioids were used[7]. Patients reported a high level of satisfaction and nearly half of the patients were discharged on the day of surgery itself. The authors did not describe a significant impact on postoperative pain.

We did not investigate the effect on costs but Buonomo et al. demonstrated added financial value for patients themselves and for the National Health System[8].

Our combination of the two locoregional blocks was chosen to achieve anterior chest wall as well as axillary anaesthesia and based on current understanding of the nerve supply to the breast and axilla (Figure 1). The second to the sixth intercostal nerves innervate the skin of the breast, gland and nipple. These are blocked by the TPVB. The ESB also gives multi-dermatomal sensory block of the anterior and lateral thoracic wall due to the cranio-caudal spread of the injected local anaesthetic agent. However, the medial and lateral pectoral nerves and the long thoracic nerve arise from the brachial plexus and supply the major and minor pectoralis and serratus anterior muscle. These are dissected or retracted during surgery and are blocked by the PECS-2 block which is especially useful during axillary surgery[2].

The TPVB can be executed on a single or several levels as described in the literature[9]. Although it is more comfortable for the patient if fewer injections are needed, our single-level injection in one patient resulted in a failed block. It is probably more appropriate to administer a multilevel block and exploit the cranial and caudal spread of local anesthetic agent as described by most publications[2,5].

The internationally accepted maximum dose of ropivacaine is 3 mg/kg or 225 mg.[10] We chose a maximum dose of ropivacaine to perform the blocks of 2.5 mg/kg because we wanted to be very careful with patients with substantial comorbidities. As we know from a recent study by Versyck et al., even a dose of 2.5 mg/kg ropivacaine for an interpectoral-pectoserratus plane block, can already exceed the threshold for local anesthetic systemic toxicity[11].
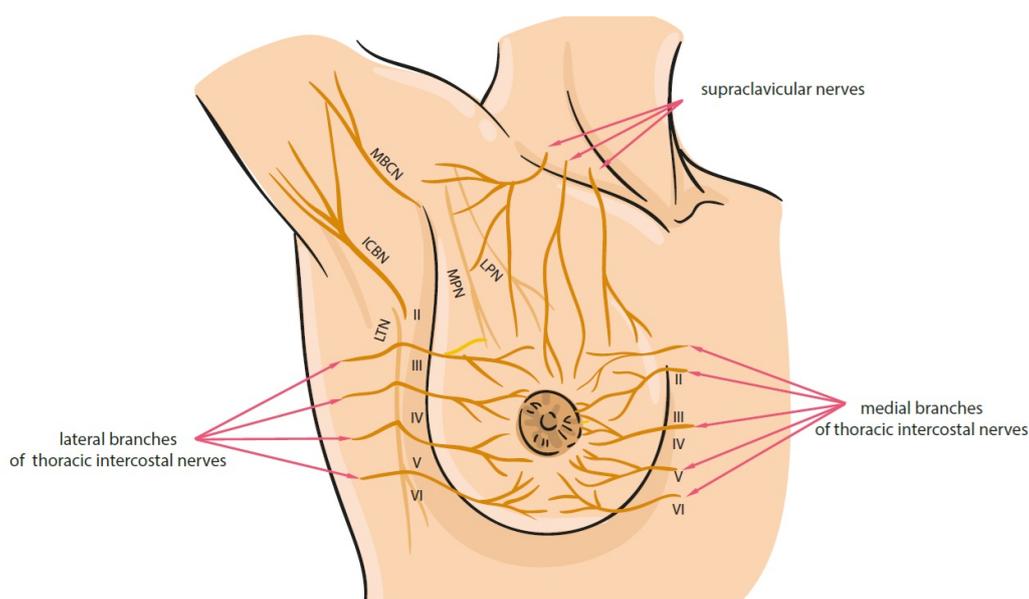

Fig. 1 — Innervation of the breast and axilla.
ICBN: intercostobrachial nerve; LTN: long thoracic nerve; LPN: lateral pectoral nerve; MBCN: medial brachial cutaneous nerve; MPN: medial pectoral nerve.
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Pre-incisional sedation and anxiolysis was achieved with titrated low-dosed ketamine and midazolam. Additional ketamine was used when the patient still felt pain during surgery. Different schemes have been described in the literature. Continuous propofol (target controlled infusion or 1-2 mg/kg/h IV) with supplemental fentanyl (0-1.5 gamma/kg), or remifentanil in continuous perfusion have been described for the same purposes[2,5-7,12]. We aimed to avoid the use of opioids as much as possible and opted to use ketamine and midazolam in small incremental doses as described by Hamilton et al[2]. Every patient's level of anxiety and stress was analysed individually and sedation was adapted accordingly. Ketamine additionally contributed to postoperative analgesia which served as an extra incentive for this chosen option. The four patients that needed extra ketamine during the intervention all complained of pain when the surgeon was working deep in the axilla. Possibly the axillary nerve has a role to play but this is something that needs further research. No anti-inflammatory drugs were administered because we wanted to prevent possible renal impairment in older patients that usually already have a deteriorated renal function.

Alternative locoregional techniques and combinations have been described. Intercostal, parasternal, interscalene blocks and even the cervical epidural have been used, with or without the combination with other blocks or tumescent anaesthesia[13-15]. The serratus anterior plane (SAP) block targets the compartment between the m. serratus anterior and m. latissimus dorsi at the level of the fifth rib and provides analgesia to the lateral part of the chest and the axilla. Vanni et al. enrolled 103 patients in a trial that compared erector spinae plane block (ESP) block with pectoral nerve block I plus serratus plane block in breast surgery[16]. There was no statistically significant difference for the VAS scores between both groups or in patient-controlled analgesia (PCA) infusion pump analysis.

The immune response following awake breast surgery was analysed by Vanni et al[17]. They enrolled 56 patients in a randomized trial who underwent breast-conserving surgery under general or local anesthesia and analyzed the impact of awake surgery on postoperative lymphocyte responses. Significant differences regarding the proportion of natural killer cells, total leukocyte and lymphocyte count were found. The authors concluded that breast-conserving surgery under local anesthesia had a lower impact on postoperative lymphocyte response when compared to the same procedure performed under general anesthesia. It is possible that, depending on the different types of tumors, surgical stress and immune suppression have an impact on the progression of tumor disease but this needs further investigation[17].

It has been suggested that ketamine may potentially have a protective immunoregulatory mechanism in patients with cancer. However, it must be noted that other data suggest that ketamine significantly suppresses NK cell activity and therefore could promote tumour metastasis. Robust evidence on whether it might influence long-term oncologic outcome requires a large, randomised trial to determine a real causal effect on cancer outcomes[18].

Some authors have tested the hypothesis that breast cancer recurrence after curative surgery is lower with regional anaesthesia-analgesia than with general anaesthesia. A retrospective analysis that examined the medical records of 129 consecutive patients undergoing mastectomy and axillary clearance for breast cancer under paravertebral block plus GA or only under GA, suggested that paravertebral anesthesia and analgesia for breast cancer surgery reduced the risk of recurrence or metastasis during the initial years of follow-up[19]. Sessler et al. concluded however in a larger study population (n, 2108), that regional anaesthesia-analgesia (paravertebral block and propofol) did not reduce breast cancer recurrence after curative surgery compared with volatile anaesthesia (sevoflurane) and opioids[20]. Currently, regional anaesthesia, when tested for its effect on oncologic outcome after tumour resection, has now been conclusively shown to be neutral[18].

Around 40% of patients suffer from chronic pain after a mastectomy or quadrantectomy (with or without axillary dissection). Early post-operative pain is one of the important conditioners[7]. Locoregional blocks might therefore be a concrete option for prevention of chronic pain, but this is actually not supported by the literature where the frequency and severity of persistent incisional breast pain seems to be unaffected by the anaesthetic technique[20,21].

The described technique might be of use in opioid free anaesthesia models or ERAS protocols.

This approach can be technically challenging and requires a motivated patient, strong teamwork and excellent communication. Patients must be seen upfront, assessed and informed about the pro's, cons and the sequence of the technique. Alternative options in case of block failure must also be discussed.

Weaknesses of this study in terms of internal validity include its retrospective nature and the lack

of comparison or control group. The small number of study subjects limits the generalizability of its findings and therefore the external validity. The database contained restricted data that made formal statistical analysis limited. More detailed data on pain scores, patient and surgical satisfaction, monitored depth of sedation would have made this master thesis more relevant. The results should therefore be viewed within this limitations.

In conclusion, the use of locoregional blocks and moderate sedation is an alternative anaesthetic technique that can be used as the principal approach for breast surgery when general anaesthesia is not warranted.

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