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Clinical Study

Influence of Lumbar Plexus Block for Proximal Modular Megaprostheses in Metastatic Bone Disease of the Femur

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Abstract. *Background* Modular megaprosthesis for proximal femur reconstruction after wide resection of metastatic lesion is a long-lasting painful procedure associated with prolonged hospital stay and significant blood loss. We evaluated the influence of lumbar plexus block on intraoperative and postoperative complications as well as length of hospital stay. *Materials and Methods* A retrospective study comparing two groups of patients for intraoperative and postoperative complications undergoing modular megaprosthesis for metastatic bone disease of the femur according to the type of anesthesia received. Group 1 included 20 patients undergoing the procedure under general anesthesia and group 2 had 19 patients undergoing the same procedure by the same surgeon under general anesthesia combined to lumbar plexus block. *Results* The two groups were comparable in terms of demographic characteristics and the primary location of the tumor except for smoking and lung cancer which were more frequent in group 1. Intraoperative variables were not statistically different between the two groups except for intraoperative blood loss ($P = 0.046$) and transfusion ($P = 0.007$). Respiratory complications were more frequent in the group 1 compared to group 2 (32% vs. 0%, $P = 0.006$) while there were no statistically significant difference for local complications, postoperative Hb and LOS. On multivariate analysis, NSAIDs consumption and general anesthesia were found to be and independent predictive factors for intraoperative blood loss. Age and ASA score were independent predictive factors for prolonged LOS. Smoking and lung cancer were predictive factors for respiratory complications. General anesthesia alone was not found to be a predictive risk factor for respiratory complications ($P = 0.245$) and prolonged LOS ($P = 0.052$). *Conclusion* Lumbar plexus block is an effective complement to general anaesthesia and intraoperative analgesic management of modular megaprosthesis for proximal femoral malignant lesions, reducing blood loss and transfusion during the surgical procedure. Prospective randomized trials are needed to confirm these findings.

Keywords: lumbar plexus block; anesthesia; prostheses; metastatic; femur

1. Introduction

Femoral bone metastases have the potential to cause significant morbidity including pain, pathological fractures, joint instability, nerve or vascular lesions, impairment of ambulation and reduced functional independence [1]. Previous research has shown that pathological fractures are observed in 9 to 29 percent of patients with long bone

metastases, and a high proportion of these require surgical intervention to relieve pain and restore function [2, 3]. The life span of patients presenting with femoral bone metastases is limited, thus, the goal of management needs to be centered on rapidly returning as much function as possible. Patients with metastatic femoral bone lesions are generally treated by open internal fixation with or without bone cement [4, 5]. However, extensive bone loss renders the open internal fixation difficult even for experienced surgeon. The procedure becomes more hazardous for lesions involving the proximal femur because of the high compressive stress passing through this weight bearing area. Therefore, many orthopedists prefer megaprosthetic reconstruction with resection of the tumor [6, 7]. However, this long lasting procedure is more invasive and associated with longer hospital stay and greater blood loss [8]. During the last two decades, developments of anesthetic modalities and availability and advances in the modular megaprostheses techniques associated with increased surgical expertise have improved the results of the treatment of proximal femoral metastatic lesions. Recently, peripheral regional anesthetic techniques are being more and more used along with general anesthesia, mainly in elderly and comorbid patients. Among these techniques, peripheral nerve blocks are gaining popularity because they provide effective analgesia and anesthesia with potentially fewer complications and side effects than central blocks [9]. The three main nerves of the lumbar plexus contribute to the innervations of the lower limb. Blockade of these nerves, combined with the sciatic blockade, can produce complete blockade of the lower limb [10]. For a complete lumbar plexus blockade, injection of local anesthetics should be performed near the lumbar plexus by tracking the needle via ultrasound or by testing its location via neurostimulation [11]. In contemporary literature, use of additional lumbar nerve blockade to general anesthesia in lower limb surgery was demonstrated to be effective, well tolerated and associated with fewer complications compared to general anesthesia alone [12]. However, no studies compared the combined use of lumbar nerve block and general anesthesia to general anesthesia alone for proximal modular megaprostheses in metastatic bone disease of the femur. Thus, the purpose of our retrospective study was to assess the additional benefit of lumbar plexus block combined with general anesthesia on intraoperative as well as postoperative complications for proximal modular megaprosthesis after extensive resection of femoral bone metastases.

2. Materials and Methods

After the approval of the Ethics Medical Committee, we reviewed the medical records and the anesthesiology chart of all patients with metastatic disease to the proximal femur treated with modular megaprosthetic reconstruction from January 1999 to December 2012 at Jules Bordet Institute. Forty nine patients with metastatic disease in the proximal femur were treated by modular megaprosthetic reconstruction. The procedure was performed by the same experienced surgeon. The following patient characteristics were searched: age, gender, weight, height, body mass index (BMI), American Society of Anesthesiologists (ASA) score, past medical history, cardiovascular risk factor including diabetes and smoking, chronic medication use including anticoagulants and non steroidal anti-inflammatory drugs (NSAID), and alcohol use. Data from the preoperative and postoperative blood tests with hematocrit/hemoglobin (Ht/Hb) and creatinine were as well as the tumor characteristics and their definitive histopathological examinations were noted. Intraoperative data were also collected: operative and anesthesia time, type of anesthesia with the product used and their dosages, type and quantity of fluid resuscitation, hemodynamic data and intraoperative blood loss, transfusion and diuresis. Postoperative complications were divided into respiratory complications, local complications and other complications. All these characteristics were represented in Table 1 and Table 2 according to the type of anesthesia used. Ten patients were excluded from the study for incomplete data. General endotracheal anesthesia was given intravenously according to the standards used in our institute. When lumbar plexus block was combined to general anesthesia, the patient was placed in the lateral decubitus position (Sim's position) with the operative side facing up and the posterior paravertebral approach at the L3 vertebral level was used [13]. The needle was inserted perpendicularly to the skin with the nerve stimulator set initially to deliver a current of 1.5 mA (1.5 mA, 2 Hz, 0.1–0.3 ms). As the needle is advanced, local twitches of the paravertebral muscles are obtained first at a depth of a few centimeters. The needle was advanced further, until twitches of the quadriceps muscle are obtained (usually at a depth of 6–8 cm). After these twitches are observed, the current was lowered to produce stimulation between 0.5 and 1.0 mA with a special attention to lower limb motor response that could indicate needle placement inside the dura mater. At this point, when the catheter is in place, a bolus of 20 ml of ropivacaine 0.5% was injected slowly without any evidence of resistance and with frequent aspirations to rule out inadvertent intravascular catheter placement. Patients were invasively monitored, with an arterial line, a central venous line and a Core Temperature measurement. Operating room temperature was maintained above metricconverterProductID20?C20□C20°C and administered fluids warmed if needed. Hemodynamic monitoring base includes cardiac monitoring by electrocardiogram (ECG), noninvasive blood pressure (NIBP), oximeter, capnography (ETCO2: end-expiratory carbon dioxide concentration), bispectral index (indicating the level of sedation and guiding the administration of anesthetics agents to maintain adequate hypnotic level). The patient's body temperature is kept constant by a heating blanket. In total, 39 patients were included in the study: 20/39 patients were offered general

Table 1: Patient preoperative characteristic distributed between the two groups.

	GA	GA + LPB	*P* value
Nb of patients	20	19	
Age, median (IQR), years	59.0 (42.0–72.0)	55.5 (50.25–67.5)	1
Gender male/female	8/12	8/11	0.642
Weight, median Kg (IQR)	64.0 (52.0–79.0)	69.0 (61.25–79.5)	0.431
Height, median cm (IQR)	167.0 (163.0–172.0)	167.0 (164.25–173.5)	0.778
BMI (kg/m2), median (IQR)	24.8 (18.39–27.23)	24.99 (22.23–27.49)	0.5
Diabetes mellitus	2	1	0.517
NSAIDs, nb of patients	2	4	0.168
Anticoagulants, nb of patients	7	8	0.839
Alcohol intake	4	6	0.292
Smoking	7	2	0.035
Primary origin of metastasis			
Prostate	1	3	0,157
Lung	12	7	0.021
Breast	6	7	0.821
Others	1	2	–
ASA score			
I	1	2	0.579
II	8	9	0.407
III	11	7	0.152
IV	0	1	0.323
Preoperative Ht	30.4 (27.8–37.4)	36.1 (31.6–40.7)	0.180
Preoperative Hb	10.8 (9.5–12.2)	12.0 (10.3–13.7)	0.273

anesthesia alone versus 19/39 patients were given general anesthesia combined to lumbar plexus block.

Variables were presented in term of median and interquartile range (IQR). In order to compare the two groups, were tested continuous variables for normality (Shapiro-Wilk). After excluding a normal distribution, a nonparametric Mann-Whitney test was thus used (Minitab 15 for Windows). Chi square test was used for non continuous variables. A log-rank test and a Cox regression model were used for univariate and multivariate analysis of the predictive factors for intraoperative blood loss, length of hospital stay and respiratory complications (R Statistical Software v2.10.1). All of the tests were two-sided and performed with a 5% alpha risk.

3. Results

Table 1 reports the preoperative characteristics of patients in group 1 and group 2. No statistically significant difference was noted between patients in group 1 and patient in group metricconverterProductID2 in2 in terms of age, gender, BMI, ASA score, medication use and the primary site of cancer. Preoperative Ht/Hb were comparable between the two groups. In addition, intraoperative variables were not statistically different between the two groups except for intraoperative blood loss ($P = 0.046$) and transfusion ($P = 0.007$) as reported in Table 2. Respiratory complications were more frequent in the group 1 compared to group 2 (32% vs. 0%, $P = 0.006$) while there were no statistically significant difference for local complications, postoperative Hb and length of hospital stay (LOS) (Table 3). On multivariate analysis, NSAIDs consumption and general anesthesia were found to be and independent predictive factors for intraoperative blood loss. Age and ASA score were independent predictive factors for prolonged LOS. Smoking and lung cancer were predictive factors for respiratory complications. General anesthesia alone was not found to be a predictive risk factor for respiratory complications ($P = 0.245$) and prolonged LOS ($P = 0.052$) (Table 4).

4. Discussion

With the advent of modern chemotherapy, the prognosis for metastatic lesions in the proximal femur has greatly improved and encouraged surgeons to consider limb salvage surgery in most centres. The use of modular prosthesis following wide resection of the tumor had become the preferred standard for malignant lesions of the proximal femur [14]. However, the procedure is challenging and technically demanding. Resection of proximal femoral tumours results in major bone and soft tissue loss, blood loss and prolonged LOS [15]. Our study show that posterior lumbar plexus block successfully

Table 2: Comparison of intra-operative data between the two groups.

	GA	GA + LPB	*P* value
Operation time, median (min)	200 (148–270)	185 (164–223)	0.833
Infusion (ml)			
Crystalloids, mean (IQR)	3000 (2000–3500)	3000 (2000–3000)	0.549
Colloids, mean (IQR)	1000 (500–1500)	1000 (500–1375)	0.806
Intra-operatives blood loss, mean ml (IQR)	1152 (640–2050)	555 (400–1500)	0.046
Intraoperative blood transfusion, median ml (IQR)	600 (250–1100)	10 (0–497.8)	0.007
Intraoperative diuresis, mean ml (IQR)	500 (400–650)	940 (375–1260)	0.343
Hb J1 ICU (g/dl)	9.9 (9.3–11.4)	9.3 (8.5–11.4)	0,518
Ht J1 ICU (%)	28.8 (27.4–32.5)	27.6 (24,9–33.9)	0.368

Table 3: Postoperative complications in group 1 and group 2.

	GA	GA + LPB	*P* value
Length of hospital stay (day)	27.0 (21.0–52.0)	18.0 (15.0–32.7)	0.078
Pulmonary complications :	8	4	0.032
Pulmonary infection (%)	6	0	0.006
Pleural effusion (%)	2	4	0.412
Local complications			
Luxation	1	1	0.970
Other complications	1 (UTI)	1 (ACFA)	–

Table 4: Predictive risk factors for intraoperative blood loss, postoperative respiratory complications and length of hospital stay.

Predictive Risk factors	F-value	*P* value
Intraoperative blood loss		
General anaesthesia	4,121	0,035
Regional anaesthesia	2,118	0,135
NSIADs consumption	6,514	0,015
Length of hospital stay		
Age	5,344	0,027
ASA score	5,146	0,005
General anaesthesia alone	3,227	0,052
Postoperative respiratory complications		
Tobacco consumption	8,693	0,003
Lung cancer	4,701	0.03
General anesthesia alone	2,816	0,245

decreased the amount of blood loss and transfusion associated with modular megaprosthesis for malignant lesions of the proximal femur. Decreased blood loss associated with lumbar plexus block had been reported in contemporary series for lower limb surgery [16–19]. However, no studies had evaluated blood loss after lumbar plexus block for modular megaprosthesis and few studies have addressed the clinical interest of peripheral nerve or plexus blocks for surgery of the hip.

The decreased intraoperative blood loss reported in our study confirms the findings of Twyman et al. [20]. The clinical importance of lower blood loss translates into less transfusion requirements in our study. Diminished haemorrhage has been documented with various regional anaesthetic techniques, including spinal and epidural anaesthesia, and is thought to result from attenuated sympathetic tone in medium and small vessels, with concomitantly reduced arterial and venous pressure [21]. Two distinct mechanisms may influence blood loss in patients undergoing peripheral nerve block: a direct effect on vasoconstrictive sympathetic fibers contained in peripheral nerves and an indirect effect mediated by antinociception and reduced systemic blood pressure. In a previous study, Stevens et al. demonstrated lower intraoperative mean arterial pressure in the lumbar plexus block group in the presence of equivalent baseline pressure measurements with similar prevalence of treated arterial hypertension in the two groups, and lesser administration of isoflurane and fentanyl in the plexus group. The authors concluded that lower mean intraoperative arterial pressure could be attributable to attenuated nociception and autonomic arousal in the block-treated patients [16]. In contrast, some authors reported no difference in blood loss between general anaesthesia and lumbar plexus block [22]. However, there are no studies reporting higher blood loss for regional anaesthesia. In a recent systematic review for total hip replacement, the authors concluded that blood loss might be decreased in patients receiving regional anesthesia compared to general anesthesia [17]. Another interesting

finding in our study was increased blood loss associated with the use of NSAID. In fact, exposure to NSAIDs inhibits the production of thromboxane and thereby the activation of platelets which increase the risk of bleeding [23].

Another important point was less respiratory complications in the group that received lumbar plexus block. However, when multivariate analysis was performed, only smoking and lung cancer were independent predictive factor. Regional anaesthesia was effective for intraoperative pain control. Ropivacaine with its efficacy for surgical anesthesia as well as the relief of postoperative pain, lower propensity for motor block, and reduced potential for central nervous system toxicity and cardiotoxicity was preferentially used, in our series, for the lumbar plexus block. A good hemodynamic stability was also noted. In general, regional anaesthesia is appreciated for the superlative and long-lasting analgesia they provide [24]. However, due to the design of our study, postoperative analgesic effect was not studied between the two groups. Moreover, when compared with other types of anaesthesia, nerve blocks may decrease risk of urinary retention, another variable not assessed by our study [25]. In addition, in the literature, the pelvic location of the primary tumor, the tumour volume and the operative time were found to be independent predictive factor for blood loss [26]. The small sample of our series had not allowed studying these factors independently.

5. Conclusion

Lumbar plexus block performed using a posterior approach is an effective complement to general anaesthesia and intraoperative analgesic management of modular megaprosthesis for proximal femoral malignant lesions. In addition, it is associated with reduction of blood loss and transfusion during the surgical procedure. Prospective randomized trials are needed to confirm reduced bleeding in the setting of peripheral nerve blockade and to explore the importance of this effect in day to day surgical practice.

Conflict of interest

The authors declare that they have no conflict of interest.

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