Anesthetic management in patient with neurofibromatosis: a case report and literature review

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Abstract: Objective: We report the anesthesia management of a 15 years-old patient with neurofibromatosis type 1, scheduled for resection of a tumor located in the occipitocervical region. In addition, we review the pertaining literature, emphasizing the anesthetic implications of neurofibromatosis manipulation.

Case: A 15-years-old female patient, with Neurofibromatosis type 1 was diagnosed with a large tumor in occipitocervical region suggestive of a plexiform neurofibroma. She presented with cervical instability, difficulty in positioning due to the large cervical mass and other predictors of airway difficulty. Awake intubation was carried out with fiberoptic bronchoscopy after anesthetic block of the airway and remifentanil infusion at low doses (0.05 mcg/kg/min). An inadvertent lesion in the left vertebral artery during the surgical procedure was well controlled by fluid replacement, red blood cell and plasma infusion and norepinephrine. The histopathological report revealed a malignant peripheral nerve sheath tumor originated from a neurofibroma in the cranio-cervical region. Two months after surgery the patient presented a right crural deficit due to tumor recurrence.

Conclusion: This case report demonstrates the importance of knowing the anesthetic peculiarities of patients affected by Neurofibromatosis type 1 submitted to surgery. Neurofibromatosis is a rare pathology in surgical centers, which requires special attention from the anesthesiologist.

Key words: Neurofibromatosis type 1; awake intubation; cervical tumor.

Neurofibromatosis (NF) is a genetic disease, transmitted as an autosomal dominant disorder, and characterized by the formation of ectodermal and mesodermal tumors. It can be divided basically into two groups with different clinical manifestations: NF1 and NF2 (1).

NF1 was first described in 1882 by Frederick von Recklinghausen and became known as von Recklinghausen’s disease (2). It presents no correlation with gender or ethnicity and has an incidence of 1 in 2500-3000 people per year throughout the world (3).

The genetic mutation on chromosome 17 expresses the gene NF-1, which produces the defec-
appearance of café-au-lait spots spread out primarily over the torso.

At 5 years of age, the patient had an insidious tumour diagnosed as neurofibroma, resected in the same location of the current lesion, but restricted to the cutaneous and subcutaneous tissue. After the resection, the only manifestation present was the café-au-lait spots, which grew in number and size. However, 3 years ago the current tumor developed and presented a faster growth rate.

The patient reported difficulties in cervical mobilization, but denied having dyspnea, dysphagia, dysgeusia. Changes in tone of voice or symptoms that suggested spinal cord compression. She denied having allergies and use of continuous medications. There was no family history of the disease.

The physical examination revealed an interincisive distance greater than 3 cm, limited cervical extension, Mallampati 4, facial asymmetry due to the size of the tumour and a deviation of the larynx noticeable upon palpation. The patient showed a painless and large mass with fibroelastic consistency in the occipitocervical region, not very movable and with no signs of phlogosis. No changes in the cardiovascular and respiratory systems were found.

The patient could walk without difficulty and presented an appropriate neuro-psychomotor development. Café-au-lait spots of various sizes were disseminated throughout the body. There were no alterations in preoperative laboratory tests.

A computerized tomography scan of the cervical spine revealed a large expansive lesion, measuring approximately 13 × 10 × 8 cm, located in the craniocervical junction and right posterior lateral cervical region, distorting the regional anatomy and invading subcutaneous tissue and adjacent skin. The

Fig. 1. — A. Neck CT – Axial – showing the arrows from left to right : bulky tumor mass, spin cervical vertebra and airway extrinsic compression with the contralateral tumor displacement. B. Neck CT – coronal section, showing bulky tumor mass in the right neck. C. Neck CT – sagittal section – demonstrating important atlantoaxial rotational dislocation.
lesion presented a component that involved the atlantoaxial joint, displacing the odontoid and touching the ventral surface of the dural sac, causing cervical instability and stenosis of the foramen magnum. A lateral right meningocele at C1-C2 (Fig. 1) was also found. These findings suggested a plexiform neurofibroma or sarcomatous degeneration. The tomography scan of the skull did not reveal alterations.

ANESTHETIC TECHNIQUE

After providing written Informed Consent, the patient was monitored with ECG, pulse oximetry, non-invasive blood pressure, a thermometer in the distal esophagus (when in the anesthetized state), and the bispectral index. Intravenous (IV) scopolamine was administered to decrease AW secretion and prophylaxis of bronchoaspiration was achieved with IV ranitidine and metoclopramide, 30 minutes before the procedure. Remifentanil 0.05 mcg/kg/min was then initiated.

The anesthetic block of the AW was performed with lidocaine 2% without vasoconstrictor. We instilled, through an atomizer, the sphenopalatine nerves and the glossopharyngeal and performed a single transcricoid injection local anesthesia with a 20 G needle plastic catheter.

Under assistance of a flexible fiberoptic bronchoscope, orotracheal intubation was performed with an 8.0 endotracheal tube with cuff. After confirmation with capnography, anesthesia was induced with propofol 120 mg, fentanyl 250 mcg and rocuronium 50 mg. A right subclavian central venous catheter and a right radial artery catheterization were performed after anesthetic induction. The patient was then positioned in the prone position (Fig. 2).

Anesthesia was maintained with sevoflurane 2%, lidocaine 3 mg/kg/h and remifentanil 0.3 mcg/kg/min. Tranexamic acid, 1.5 g, was administered in bolus and maintained in continuous infusion at 10 mg/kg/h.

During surgery, there was an inadvertent lesion of the left vertebral artery, which evolved with hemodynamic instability, hemorrhagic shock and the need for clipping the vessel. The mean arterial pressure fell to 35 mmHg, but with the administration of 1000 mL of crystalloid and norepinephrine (0.3 mcg/kg/min) rapidly increased to 60 mmHg. The arterial blood gases showing 5 g/dL of hemoglobin and the central venous blood gases a venous saturation of 60%, we decided to transfuse red blood cells, 5 units in total. In addition, 3 units of fresh frozen plasma and prothrombin complex 1500 Iu were also infused, because the bleeding continued in the operatory field despite surgical repair. A tumor measuring 16 × 12.5 × 8 cm was removed and arthrodesis of C2-C4 was performed.

The patient was referred to the ICU, intubated, after 8h of surgical procedure and 9 h and 30 minutes of anesthesia. She was extubated after 18 h of ICU admission, referred to the ward on the third postoperative day (POD) and discharged at 26 POD. The histopathological report revealed a malignant peripheral nerve sheath tumor originated from a neurofibroma of the craniocervical region, with high cellularity and 10% necrosis. Two months after the surgical procedure, the patient had right lower limb hemiparesis due to local recidive with spinal cervical compression.

Fig. 2. — A. Patient supine, demonstrating the attitude lateral rotation of the neck due to the bulky right neck mass. B. Surgical patient positioning prone with support gel for the face, still showing in profile the massive neck mass.
DISCUSSION

The cutaneous manifestations of NF-1 usually appear in childhood. The café-au-lait spots, axillary and inguinal freckles and Lisch nodules usually have no clinical repercussions. The neurofibromas, however, occur in approximately 30-50% of cases, increasing in size during adolescence and pregnancy, with a high potential for malignant transformation, which occurs in 2-5% of cases and are the main cause of death (2).

The classification of neurofibromas is controversial but generally includes cutaneous, subcutaneous, and plexiform types. Plexiform neurofibromas may cause compression of the spinal cord and nerve roots, pain and vertebral erosion. The development of malignancy can occur inside a benign nodule and presents some characteristics suggestive of malignancy, such changes in size of a preexisting mass and compression or infiltration of adjacent structures (12). These tumors are considered sarcomas and are 100 times more frequent in this population (13).

NF offers a challenge to the anesthesiologist because of the variety of comorbidities in many organs and systems. Some abnormalities of interest for anesthetic-surgical procedures are short stature and bone abnormalities, in addition to cardiovascular abnormalities, such as congenital cardiac malformations, vasculopathy and hypertension. Cognitive disorders, in addition to attention and hyperactivity disorders, can be found (2). There is a greater prevalence of neurofibromatosis 1 in patients with other neoplasms, such as rhabdomyosarcomas, gastrointestinal stromal tumors (GIST), pheochromocytomas, carcinoid tumors and ganglioneuromas (14).

The diagnosis of NF1 is essentially clinical, and, therefore it is important to observe its signs in the pre-anesthetic evaluation. In addition, the differential diagnosis of patients with pigmented spots must be made with the McCune-Albright and Peutz-Jeghers syndromes and Addison’s disease, due to possible issues related to the surgical procedures (6).

There are countless anesthetic implications. Approximately 5% of patients with NF-1 present manifestations of the disease in the oral cavity, which may hinder or even prevent conventional orotracheal intubation. In addition, tracheostomy may be necessary if such manifestations are not identified prior to the induction of anaesthesia (12). Facial malformations can result in facial asymmetry due to bone involvement and contribute to difficulties during ventilation and intubation (15).

Large cervical masses can distort the airway, in addition to causing potential cervical instability due to involvement of the vertebrae. Those masses make airway management more difficult, making awake intubation using fiberoptic bronchoscopy necessary. This procedure is the gold-standard technique in these cases according to the American Society of Anesthesiology (16). Suggestive evidence of a difficult airway or history of difficult intubation is an indication for intubation with this technique. Airways that are compromised by infection, edema, hematoma, limited oral opening, macroglossia, obesity, inability to extend the neck or cervical instability, sleep apnea, Mallampati classification III or IV, protruding or weak teeth (17) are all indications for awake intubation.

To decrease the airway reflexes, a topical anesthesia may be performed with lidocaine with an atomizer, or through instillation by the bronchoscope itself, or even via the transtracheal route (18). Sedation can be accomplished with the drug of choice of the anesthesiologist, but must maintain the patient’s spontaneous breathing. The literature suggests dexmedetomidine (19). In this particular case, the choice was remifentanil in low doses, which is also well tolerated during bronchoscopy (20). General anesthesia should not be induced because of a high risk of being unable to ventilate or intubate the patient (21).

Most patients with cervical masses are asymptomatic because of uncritical anatomical relations to the spinal cord and spinal canal. However, a substantial proportion has pain, especially during rotation, as a symptom. Neurological alterations may also occur through complete or incomplete lesions of the spinal cord (22). Large mediastinal masses may be present and impair the ventilation of these patients. These tumors may lead to scoliosis and cause respiratory disorders and cardiovascular complications, features that were not found in our patient. A computerized tomography (CT) of the thorax and pulmonary function tests are informative especially in symptomatic patients (9).

The investigation during the preoperative period should include primary systemic hypertension and renal artery stenosis, as they are the most frequent manifestation of cardiovascular impairment. These manifestations indicate that nephrotoxic drugs should be avoided during surgery. Hypertension investigation should include urinary levels of catecholamines and abdominal CT, with a search for pheochromocytomas, as they frequently occur in this population (1).
During the intraoperative period, fluctuations in blood pressure or cardiac arrhythmia should raise the suspicion of a carcinoid tumor or pheochromocytoma. If not diagnosed before surgery, because of no clinical symptoms, the patient can develop intraoperative hypertensive crisis after surgical manipulation or usage of triggering drugs such as beta-blockers and ketamine (24). Compression of vena cava and low cardiac output may be caused by mediastinal mass involvement, causing severe hypotension during surgery (25).

Blood pressure maintenance during central nervous system (CNS) tumors resection is an important feature for the anesthesiologist, as patients with NF1 have a high possibility of presenting associated vasculopathies. The presence of vasculopathies represents an increased risk of cerebral ischemia and aneurysm rupture (1). The anesthesiologist must also be aware of the risk of severe hemorrhaging by tumor invasion of adjacent structures and the presence of other non-diagnosed CNS tumors (3).

The use of neuroaxis block, usually done in pregnant women, can be a challenge to the anesthesiologist if the patient presents spinal alterations, such as scoliosis or spinal cord tumours (9).

Differences in the characteristics of depolarizing and non-depolarizing neuromuscular blockers have been the focus of some studies, which have shown that these drugs can be safely used in neurofibromatosis patients.

In conclusion, the reported case presents the anesthetic peculiarities of a NF1 patient and shows the importance of a proper management of anesthesi management for a favorable outcome.

References