

# Accepted Manuscript

Successful treatment of Neuroblastoma in an adolescent with Intra-Arterial Embolization before surgery

Luca Pio, MD, Stefano Avanzini, Carlo Gandolfo, Giuseppe Martucciello, Claudio Granata, Alessandro Boscarelli, Alberto Garaventa, Girolamo Mattioli



PII: S2213-5766(17)30011-8

DOI: [10.1016/j.epsc.2017.02.015](https://doi.org/10.1016/j.epsc.2017.02.015)

Reference: EPSC 714

To appear in: *Journal of Pediatric Surgery Case Reports*

Received Date: 14 January 2017

Revised Date: 21 February 2017

Accepted Date: 24 February 2017

Please cite this article as: Pio L, Avanzini S, Gandolfo C, Martucciello G, Granata C, Boscarelli A, Garaventa A, Mattioli G, Successful treatment of Neuroblastoma in an adolescent with Intra-Arterial Embolization before surgery, *Journal of Pediatric Surgery Case Reports* (2017), doi: 10.1016/j.epsc.2017.02.015.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

## **Successful treatment of Neuroblastoma in an adolescent with Intra-Arterial Embolization before surgery**

Luca Pio<sup>1,2</sup>, Stefano Avanzini<sup>1</sup>, Carlo Gandolfo<sup>1,3</sup>, Giuseppe Martucciello<sup>1,2</sup>, Claudio Granata<sup>1,4</sup>, Alessandro Boscarelli<sup>1,2</sup>, Alberto Garaventa<sup>5</sup>, Girolamo Mattioli<sup>1,2</sup>

1- Pediatric Surgical Unit, Istituto Giannina Gaslini, Genoa, Italy

2- DINOEMI, University of Genoa, Italy

3- Neuroradiology Unit, Istituto Giannina Gaslini, Genoa, Italy

4- Radiology Unit, Istituto Giannina Gaslini, Genoa, Italy

5- Oncology Unit, Istituto Giannina Gaslini, Genoa, Italy

\*Corresponding Author:

Luca Pio, MD, Pediatric Surgery Unit, Istituto Giannina Gaslini;

Largo G. Gaslini 5, 16147 Genoa, Italy.

Tel. +39-010-56362217; Fax +39-010-3075092

Email: [lucakeats@hotmail.it](mailto:lucakeats@hotmail.it)

## Abstract

Introduction: Neuroblastoma in the adolescent is characterized by indolent growth and poor outcome.

Surgical resection of the tumor is an essential part of the multimodality treatment. Surgical complications depend on the presence of Image Defined Risk Factors (IDRFs).

Methods: We present an adolescent with pelvic neuroblastoma and epidural compression. To facilitate tumor resection, the patient underwent preoperative selective embolization.

Results: After selective embolization a subsequent complete resection intraspinal localisation was performed without complication with complete remission after 2 years.

Conclusions: Preoperative embolization is a safe and feasible technique that can help pediatric surgical

oncologist to reduce complications IDRFs-related.

Key words: Embolization, Neuroblastoma, Pediatric Surgical Oncology, IDRFs, Adolescent

## Introduction

Neuroblastoma (NB) is a pediatric solid tumor with an highly variable clinical presentation, from localized to widely disseminated disease. The main prognostic factors include age at time of diagnosis, extent of disease, and some biologic tumor features, such as amplification of MYCN oncogene. The recent International Neuroblastoma Risk Group Staging System (INRGSS) represents a preoperative radiological classification. INRGSS identified the vascular involvement and/or encasement as the main surgical risk factors. [1]

Intra-arterial embolization is performed by using a coil or different types of gelatin microspheres [2]. The aim of embolization is to reduce a tumor's vascular supply, in order to reduce the risk of bleeding during operation. It has been proved safe and effective in pediatric tumors and, in addition to classical treatment, contributing to the management of these patients. [3-6]. Almost all the studies reported that the embolization technique performed to reduce respiratory impairment due to diaphragm elevation for Neuroblastomas 4s with massive hepatomegaly which had not responded to chemotherapy, resulted in decreased intra-abdominal. Only Krauel described two non hepatic procedures: one being a mediastinal NB pre-operative treated with embolization in order to reduce surgical hemorrhage risk and the other being a case using embolization to treat a massive hemorrhage after a tru-cut biopsy [7].

We present for the first time the case of an Adolescent Neuroblastoma diagnosed with pelvic NB, where embolization helped to achieve complete tumor ablation.

## Case Presentation

A 17-year-old male presented to our Pediatric Surgery Unit due to neurological bladder, faecal incontinence and sensory anaesthesia extended from S3 to S4. Blood pressure was normal. Abdominal ultrasound showed a solid presacral mass extending into the spinal canal.

Magnetic resonance imaging showed a localized neuroblastoma measuring 9.4 x 7.8 x 7.8 cm with the typical features of an intraspinal involvement in more than one third of the spinal canal, (Fig. 1) and encasement of internal iliac vessels.

After sacral decompressive laminectomy, laparoscopic biopsy of the tumor was performed and confirmed a stroma-poor neuroblastoma poorly differentiated without MYCN oncogene amplification based on the International Neuroblastoma Pathology Classification (INPC) .

The patient was considered to have a stage L2 INRGSS [8] disease and was consequently treated with chemotherapy according to the Intermediate risk protocol. After 4 chemotherapy courses (LINES protocol), the tumor response was evaluated by magnetic resonance which showed the reduction of approximately one third of the mass, measuring 6 x 5 x 4.5 cm. At this time, to make the attempt at tumour resection more feasible and less risky, endovascular tumour devascularisation was taken into consideration and carried out via right contralateral transfemoral approach using a 4-french valved sheath. The main arterial feeder of the pelvic mass was superselectively catheterized (using a 2.7-french microcatheter) and then embolized, first using a gelatin sponge (Spongostan Haemostatic®) and finally sealed using glue (Glubran2®). The final control showed complete devascularisation of the mass and preservation of the medial splanchnic branches of the internal iliac artery (Fig 2).

The subsequent day, tumor resection with posterior sagittal approach was undertaken and

turned macroscopically complete resection without complications (in particular, no rupture of the mass, neither hemorrhage occurred).

The postoperative course was uneventful and the patient underwent post-operative chemotherapy and radiotherapy (21 Gy). With a follow-up of 2 years patient is alive, tumor free without local residual tumor; Neurologic sequelae are limited to the need of Valsalva maneuver to full bladder voiding.

## Discussion

Adolescents with Neuroblastoma have a poor overall survival rate of between 20% with a 22% of event free survival at 10 years [9], and surgical resection represent the main treatment. NB is characterized by indolent growth as reported in this case, when localized in the pelvis may cause neurologic damage, mainly sphincter dysfunction and sensory deficit. Despite several studies reporting on symptomatic epidural compression in infants with NB, there is a lack of literature on AN with spinal canal involvement [10].

IDRFs are features detected on diagnostic imaging that make total tumor excision difficult and risky at the time of diagnosis. The attempt at tumor resection in presence of IDRFs lowers the chance of complete resection rate and implies greater risk of surgery-related complications [11].

Preoperative chemotherapy represent the most important treatment to reduce IDRFs before surgery, but other treatments can be taken into consideration to facilitate surgery, as preoperative embolization, that has been largely used in several adult tumors [12].

Pediatric interventional radiology is an emergent speciality that can be used in different fields of pediatric oncology as ultrasonography\computed tomography-guided biopsies, central venous catheter placement, radiofrequency ablation or angioembolization.

In our experience, preoperative embolization is often recommended mainly to reduce bleeding risk during major surgical procedure. Both liquid and particulate embolic agents can be used in experienced hands to achieve this goal. They can also be used simultaneously (as in this case) according to the specific angioarchitecture and blush of the tumour and to the surgical timing (particulate materials provide a distal transitory devascularisation and should be used when surgery is planning within the following 24-36 hours). In our case, the injection of glue following particulate distal embolization led to uneventful recovery.

One of the disadvantages of embolization is that given the tumor-related vascular supply, only a few neuroblastoma are highly vascularised. The other limitations is that this is an irradiation technique. The advantages of this technique are the selective closure of vascular supply of the tumour and the possibility to perform this technique without any delay of the subsequent surgical resection.

Preoperative embolization is a feasible and safe technique that can be considered to reduce bleeding risk in local aggressive surgery for NB. To date pre-operative embolization is not a standardized procedure in currents protocols, in the absence of international recommendations, its utility must be defined with the national principal investigator for NB.

## References

1. Brodeur GM, Maris JM. Neuroblastoma. In: Pizzo PA, Poplack GD, editors. Principles and practice of pediatric oncology. 4th edition. Philadelphia: Lippincott Williams and Wilkins; 2002:895–938.
2. Hogarty MD. The requirement for evasion of programmed cell death in neuroblastomas with MYCN amplification. *Cancer Lett* 2003;197:173–179.
3. Malogolowkin MH, Stanley P, Steele DA, Ortega JA. Feasibility and toxicity of chemoembolization for children with liver tumors. *J Clin Oncol* 2000;18:1279–1284.
4. Weintraub M, Bloom AI, Gross E, et al. Successful Treatment of Progressive Stage 4s Hepatic Neuroblastoma in a Neonate With Intra-Arterial Chemoembolization. *Pediatr Blood Cancer* 2004;43:148–151
5. Boztug K, Kiely E, Roebuck DJ, et al. Successful Treatment of MYCN Amplified, Progressive Stage 4S Neuroblastoma in a Neonate With Hepatic Artery Embolization in Addition to Multimodality Treatment. *Pediatr Blood Cancer* 2006;46:253–257
6. Weintraub M, Waldman E, Koplewitz B, et al. A sequential treatment algorithm for infants with stage 4s neuroblastoma and massive hepatomegaly. *Pediatr Blood Cancer*. 2012;59(1):182-4.
7. Kael L, Albert A, Mora J, et al. Use of angioembolization as an effective technique for the management of pediatric solid tumors. *Journal of Pediatric Surgery* 2009; 44:1848–18557.
8. Brisse HJ, McCarville MB, Granata C, et al. International Neuroblastoma Risk Group Project. Guidelines for imaging and staging of neuroblastic tumors: consensus report from the International Neuroblastoma Risk Group Project. *Radiology* 2011;261(1):243-57



9. Conte M, Parodi S, De Bernardi B, et al. Neuroblastoma in adolescents: the Italian experience. *Cancer* 2006;106(6):1409-17.
10. De Bernardi B, Quaglietta L, Haupt R, et al. Neuroblastoma with symptomatic epidural compression in the infant: the AIEOP experience. *Pediatr Blood Cancer* 2014;61(8):1369-75.
11. Warmann SW, Seitz G, Schaefer JF, Scheel-Walter HG, Leuschner I, Fuchs J. Vascular encasement as element of risk stratification in abdominal neuroblastoma. *Surg Oncol*. 2011;20(4):231-5
12. El Rafei M, Renard B, Puech P, Devos P, Gaillard V, Lemaître L. Tumor necrosis after preventive embolization of large renal angiomyolipomas. *Diagn Interv Imaging* 2015;96(6):579-87.

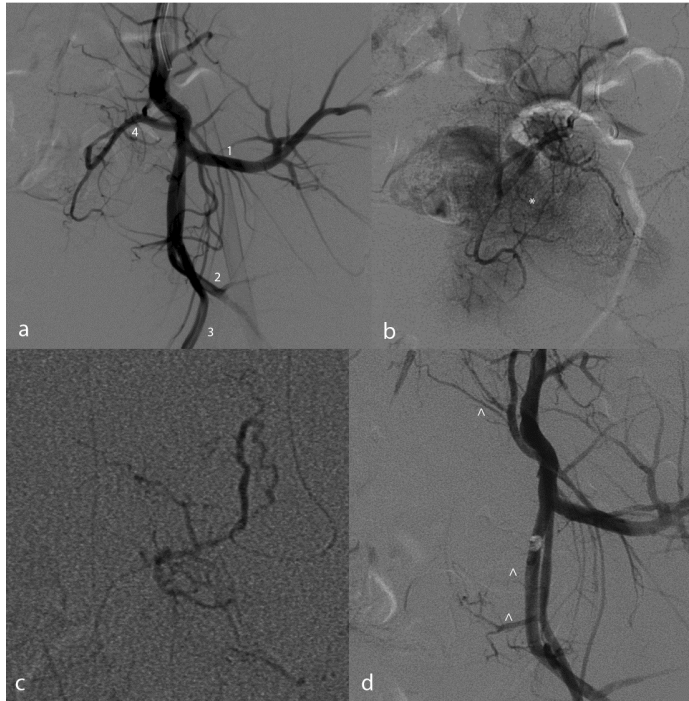
#### Figure legend

Figure 1. Magnetic resonance finding: the sagittal plane shows a huge mass extending into sacral spinal canal.

Figure 2. Diagnostic and interventional angiography. A previous panoramic (a) and superselective (b) angiograms were obtained: the typical appearance of the internal iliac artery (IIA) showed its main branches (1: gluteal, 2: sciatic, 3: pudendal, and 4: obturator). A pathologic blush was depicted after selective obturator branch injection (\*). The final glue cast disposition (c) provided a complete amputation of the tumour feeding branches; a relative preservation of medial splanchnic arteries (^) can be appreciated with the final injection of the IIA.



ACCEPTED MANUSCRIPT



## Highlights

- First report of pre-operative embolisation in an adolescent with Neuroblastoma
- Description of interventional radiology procedure
- Description of an alternative technique in order to prevent surgical complications

ACCEPTED MANUSCRIPT