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Case report

Unresectable recurrence malignant sacrococcygeal teratoma in children treated with chemoradiotherapy: Case report and literature review

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ARTICLE INFO

Article history:

Received 21 January 2019

Received in revised form 5 May 2019

Accepted 1 June 2019

Available online 22 June 2019

Keywords:

Malignant sacrococcygeal teratoma

Chemotherapy

Radiotherapy

ABSTRACT

Sacrococcygeal teratoma is the most common germ cell neoplasia that consists of tissues derived from primitive germ layers. Approximately 10–20% of patients are malignant. Because of the high rate of recurrence, treatment strategies for malignant sacrococcygeal teratomas are limited. Hence, we report a case of malignant sacrococcygeal teratoma treated with concurrent chemoradiotherapy plus adjuvant chemotherapy and review the literature. This case report indicates that chemoradiation plus adjuvant chemotherapy may be a treatment option for malignant SCT which is not technically resectable or with residual lesion after surgery.

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1. Introduction

Sacrococcygeal teratoma (SCT) is one of the most common neoplasms in new-borns with an incidence of 1 in 15,000–40,000 live births.¹ Approximately 10–20% of the neoplasms are malignant.² This incidence increases dramatically if the surgery is delayed or with incomplete resection even though it is benign at the first diagnosis.^{3,4} Limited strategies can be used for unresectable recurrence patients. Here we share our experience by reporting one case of malignant

sacrococcygeal teratoma treated with concurrent chemoradiotherapy plus adjuvant chemotherapy and reviewing the literature.

2. Case description

A 2-year-old Tibetan boy was admitted to our hospital due to a sacrococcygeal mass found two years after surgical treatment of sacrococcygeal teratoma. Due to the lack of prenatal care, the mass measuring 8 cm × 10 cm, with a feeble texture,

Abbreviations: SCT, sacrococcygeal teratoma; MRI, magnetic resonance imaging; AFP, α -fetoprotein; hCG, human chorionic gonadotropin; PEB, etoposide (VP-16), cisplatin (DDP) and bleomycin (BLM); VMAT, volume-modulated arc therapy.

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<https://doi.org/10.1016/j.rpor.2019.06.002>

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Fig. 1 – Pelvic MRI of patient before treatment. (A) T2WI at sagittal section; (B) enhanced TIWI at sagittal section; (C) T1WI at axial section; (D) enhanced TIWI at axial section; (E) T2WI at axial section; tumor with hyperintensity in T2WI involved the tibia, bilateral humerus, spinal canal, bladder and adjacent muscles. It showed mild to moderate enhancement with a wide involvement of the adjacent structures and regional necrosis in enhanced TIWI.

Table 1 – Dose & fraction and target definition in three courses of treatment plans.

Plan	GTV1 (close to the skin)	GTV2 (close to the bladder)	CTV (close to the rectum)
Plan1*5F,qd	300 cGy/F	250 cGy/F	180 cGy/F
Plan2*5F,qd	250 cGy/F	220 cGy/F	180 cGy/F
Plan3*4d,bid	180 cGy/F	150 cGy/F	150 cGy/F
Total dose	4190 cGy	3250 cGy	3000 cGy
(BED)	(5000 cGy)	(4000 cGy)	(3240 cGy)

was first found in the sacrococcygeal area after birth. Seven days later, the infant was sent to a hospital. Tumorectomy was performed on the 8th day after birth. The pathology after surgery confirmed it to be mature teratoma. No additional treatments were given postoperatively and no regular follow-up was arranged till finding a sacrococcygeal mass.

A month before the child came to our hospital, a mass in the sacrococcygeal region was once again found by his parents. The mass measuring 9.0 cm × 6.0 cm, with a feeble texture and tenderness, was confirmed by a magnetic resonance imaging (MRI) scan afterwards (Fig. 1). Multiple

coccygeal vertebra and sacral vertebrae were destroyed by the lesions. A mixed enhancing mass located near the paravertebral and intraspinal was found on MRI image. The serum α -fetoprotein (AFP) concentration was 1210.00 ng/ml and human chorionic gonadotropin (hCG) concentration was 0.77 ng/ml. Muscle strength was grade 4 on lower limbs. Electrocardiogram, routine clinical examination of the chest and abdomen were normal.

However, the mass was so enormous that surgical treatment could not be considered because of invading the surrounding tissues and structures. The pathology after

Fig. 2 – Treatment plan of the first course. (A) DVHs of treatment plan. (B) Isodose of treatment plan on axial direction. (C) Isodose of treatment plan on sagittal direction. 300 cGy, 250 cGy and 180 cGy per fraction was prescribed to GTV1, GTV2 and GTV3 for a total of 20 fractions; in fact, the patient received 5 fractions of treatment for this plan because of re-plan after tumor reduction.

biopsy confirmed it to be endodermal sinus carcinoma. Treatment strategy for the boy was concurrent chemoradiotherapy plus adjuvant chemotherapy. From January 23rd 2015 to March 16th 2015, the boy received radiotherapy in our radiation oncology center. Concurrent chemotherapy for three cycles of PEB (DDP + VP16 + BLM) was given to the boy from January 26th to March 18th. Afterwards, another 4 cycles of adjuvant chemotherapy with PEB regiment were administered to the boy in a community hospital.

2.1. Radiation oncology details

Image-guided intensity modulated radiotherapy and adaptive radiation therapy techniques were applied for this special case. Radiotherapy was performed on Elekta Axesse radiation system with volume-modulated arc therapy (VMAT). 6 MV of X ray was used for the planning and treatment plan was

optimized on the Oncentra planning system (version 4.3). MRI and CT images were fused in the same section to better define the volume. Tumor volume was divided into three parts according to the location and surrounding organs. GTV1 was defined as a tumor volume that is close to the skin which would receive higher dose in each fraction, GTV2 was defined as a tumor volume that is close to the bladder that would receive inter-median dose and CTV was defined as a volume that is close to the rectum that would receive relatively lower dose to protect the rectum. The child received three courses of radiation plan and a total of 5000 cGy (BED), 4000 cGy (BED) and 3240 cGy (BED) were prescribed to GTV1, GTV2 and CTV (Table 1). Fig. 2 showed the treatment plan of the first course in which 300 cGy, 250 cGy and 180 cGy per fraction was prescribed to GTV1, GTV2 and GTV3 for a total of 20 fractions (the treatment planning was designed to receive a total of 20 fractions for better evaluating dose of organs at risk; however, the

Fig. 3 – patient setup and surface reconstruction based on CT data. (A and B) The child was set up under shallow anesthesia by chloral hydrate on a vacuum pad in a comfortable posture. (C and D) Surface reconstruction of the patient before treatment (C) and at the end of radiotherapy (D) based on CT scan. Tumor in the sacrococcygeal region was significantly reduced compared to the images before treatment.

Fig. 4 – Dynamic changes of the serum AFP concentration during treatment.

patient actually received 5 fractions of treatment because of re-plan after tumor reduction).

The child received radiotherapy and CT/MRI scanning under shallow anesthesia by chloral hydrate on a vacuum pad in a comfortable posture (Fig. 3A and B). 5–8 ml of chloral hydrate (10%) was fed before nap. When the boy fell asleep (about 30 min after drinking chloral hydrate), he was sent to the treatment room or CT/MRI simulation room. The same procedure was repeated every time before treatment.

3. Treatment outcome & toxicity and follow up

During the chemoradiotherapy period, the boy once experienced chills and fever. Blood culture showed: *Klebsiella pneumoniae* (+). Imipenem and ceftriaxone were used to overcome the septicemia infection. Grade II myelosuppression occurred and it was corrected by supportive care. At the end of treatment, the tumor was significantly reduced (Fig. 3C and

Fig. 5 – Pelvic MRI of patients at the fourth year after treatment. (A) Enhanced TIWI at sagittal section; (B) T2WI at sagittal section; (C) T2WI at axial section; (D) T1WI at axial section. (E) Enhanced TIWI at axial section. No sign of recurrence was found on TIWI, T2WI and enhanced TIWI in all the directions. Only mild inflammation and edema can be seen on T2WI and enhanced TIWI with mild to medium hyperintensity near the original tumor area (posterior wall of the bladder and adjacent muscles).

D) and the laboratory examination showed that the serum AFP concentration recovered to normal level (Fig. 4). At the fourth year of follow-up, the MRI showed no sign of recurrence (Fig. 5), the boy could walk at normal pace and the AFP was at normal level. Now, the case is under further follow-up.

4. Discussion

Teratomas can occur in regions throughout the body, including the gonads, anterior mediastinum, retroperitoneal space and perineal area, but, most frequently, involve the sacrococcygeal region in infancy.⁵ According to the histological composition and degree of maturation or differentiation, teratomas are classified as mature or immature. The majority of teratomas are mature and 20–25% cases are immature.⁶ SCT accounts for nearly 40% of all cases of teratomas found in children with 75–80% of them occurring in females.⁷ Early diagnosis can be

made in the first three months of pregnancy,⁸ approximately 80% are diagnosed within the first month of life.⁹ In patients unsuitable for complete resection, diagnosis may be established based on imaging and tumor markers.¹⁰ As described by Altman et al., patients with SCT were categorized into four types according to intra-abdominal or presacral extension.¹¹

Symptoms, such as anemia, musculoskeletal abnormalities, currarino syndrome and bladder or intestine dysfunction, can be found in part of patients with a chronic course, advanced stage or malignant transformation.^{12,13} Prognosis of SCT depends on the extent of surgical resection and histopathological findings of tumor (benign or malignant). Furthermore, faster SCT growth is associated with adverse outcomes.

The occurrence of malignancy can usually be found in patients at older age at diagnosis as well with less apparent lesions (type II–IV). Recurrent tumors occur in 4–21% of SCTs, which are often malignant, at least 50% of them

being malignant yolk sac tumors.¹⁴ Especially immature teratomas show an increased incidence of local recurrence and malignant degeneration. Based on the tendency of SCTs to recurrence, serial serum alpha-fetoprotein (AFP) samples which are valuable in differentiating between mature and malignant teratoma at presentation, have been recommended to detect malignant recurrences at follow up. On the other hand, elevated serum CA-125 may indicate non-malignant recurrences.¹⁵

Malignant sacrococcygeal teratoma, including related malignant tumor of germ cell derivation, may occur in an otherwise benign or immature teratoma. Although strictly speaking, these are not teratomas, they are obviously closely related, occur in the same sites and can be grouped with the teratomas for clinical purposes.¹⁶ Endodermal sinus (yolk sac) tumor, the only histological type of malignancy in the present series, is the most common of these to occur in young children.

The primary therapy for all SCT is excision soon after birth. It is adequate if the tumor is benign. However, the majority of malignant teratomas are not technically resectable since most fill the pelvis obstructing the urinary tract and the rectum by the time they are found.¹⁵ In this study, the children who once received surgical treatment lost the chance of a complete resection for the reason of malignant degeneration.

In addition to surgery, chemotherapy and radiotherapy are two major treatment strategies available for malignant SCT. Patients should receive additional treatment with chemotherapy and/or radiotherapy. Prognosis of malignant sacrococcygeal tumor was worse before the development of modern chemotherapy, with a survival rate of 60% with chemotherapy in the form of cisplatin and bleomycin after resection of malignant sacrococcygeal tumor.^{17–19} However, there is no standard recommendation for the use of chemotherapy or radiation. Narendra Kumar et al. reported a 37-year-old male SCT patient who was diagnosed as adenocarcinomatous transformation in a mature teratoma. He was given post-operative radiotherapy, a dose of 45 Gy in 25 fractions at 1.8 Gy per fraction over 5 weeks followed by adjuvant combination chemotherapy with bleomycin, etoposide and cisplatin for three cycles. Unfortunately, recurrence occurred at 6 months after completion of treatment.²⁰ In literature, radiotherapy was unofficially suggested for patients with residual lesions or/and a rising AFP level after surgical resection and chemotherapy. In this study, the case was not technically resectable with a relatively higher serum AFP level. Concurrent chemoradiation plus adjuvant chemotherapy were scheduled. An inspiring outcome may be worth expecting.

5. Conclusion

On the basis of the case we report, we can assume that chemoradiation plus adjuvant chemotherapy may be a treatment option for malignant SCT that is technically unresectable or with residual lesion after surgery. However, further studies with a large sample are still warranted.

Conflict of interest

None declared.

Financial disclosure

The study was supported by National Key Research and Development Plan (2017YFC0113100).

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