

Change in Standard Uptake Value after Neoadjuvant Chemotherapy Correlates with Necrosis and Length of Survival in Pediatric Osteosarcoma

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BACKGROUND

- Osteosarcoma (OS) and Ewing sarcoma (EwS)**
 - Most common pediatric bone cancers
 - Treated with neoadjuvant chemotherapy (NAC) prior to surgical resection
- Histologic necrosis = gold standard prognostic marker**
 - Requires resection, labor-intensive
- Maximum standardized uptake value (SUV_{max})**
 - Measured in pre- and post-NAC PET scans
 - Quantitative metric of metabolic activity in tumors

AIMS

- 1) To investigate the utility of SUV_{max} as a surrogate for histologic response and survival in pediatric sarcoma

METHODS

- Single-center retrospective cohort
- 39 OS, 16 EwS – 2009-2023
- Variables:
 - Demographics
 - SUV_{max} at primary tumor site (“SUV”)
 - Length of survival (months) after diagnosis
 - Status of metastasis after NAC
 - Tumor stage & anatomic location
- OS: % Necrosis after NAC stratified by Huvos grade
 - Grade I = <50% necrosis; II = 50-89.9%; III = 90-99.9%; IV = 100%
- EwS: 100% necrosis = “responsive” to NAC
- Linear regression analyses performed to evaluate predictor candidates for tumor necrosis and survival duration

Table 1. Demographics and survival outcomes grouped by tumor histology

	All (N=55)	OS (N=39)	EwS (N=16)
Age at diagnosis, mean (SD)	13.2 (4.4)	13.6 (4.4)	12.1 (4.2)
Race/Ethnicity, n (%)			
Caucasian	47 (85)	34 (87)	13 (81)
Black/AA	5 (9)	5 (13)	0
Other	3 (5)	0	3 (19)
Tumor Stage, n (%)			
1	18 (33)	11 (28)	7 (44)
2	32 (58)	26 (67)	6 (38)
3	3 (5)	2 (5)	1 (6)
4	1 (2)	0	1 (6)
Anatomic Site, n (%)			
Femur	26 (47)	21 (54)	5 (31)
Tibia	13 (24)	9 (23)	4 (25)
Other	16 (29)	9 (23)	7 (45)
SUV pre-NAC, g/mL (mean, SD)	8.5 (4.1)	9 (4.3)	7.5 (3.6)
SUV post-NAC, g/mL (mean, SD)	3.2 (1.7) [†]	3.4 (1.7) [†]	2.9 (1.7) [†]
ΔSUV, g/mL (mean, SD)	-5.3 (4.2)	-5.6 (4.4)	-4.6 (3.4)
Months survived, mean (SD)	66 (42)	64 (45)	70 (37)
Months in remission, mean (SD)	46 (40)	44 (42)	52 (38)
Survival, n (%)	37 (67)	25 (63)	12 (75)

[†]Kruskal-Wallis test with statistical significance set at p < 0.05. ΔSUV – change in maximum standard uptake value after neoadjuvant chemotherapy; CI – Confidence interval.

Table 2. Higher OS Huvos grade correlates to higher necrosis and SUV decrease

Huvos	Patients (%)	Percent Necrosis (%)			p [†]	ΔSUV (g/ml)			p [†]
		Mean	SE	95% CI		Mean	SE	95% CI	
1	6 (15)	24.2	6.1	[11.8, 36.5]	0.0001	-1.1	0.6	[-2.3, 0.2]	0.0039
2	11 (28)	75.3	3.3	[68.6, 81.9]		-5.3	1.4	[-8.2, -2.5]	
3	19 (49)	95.5	0.6	[94.3, 96.6]		-6.9	0.7	[-8.3, -5.4]	
4	3 (8)	100	0	-		-8	5.2	[-18.4, 2.4]	

[†]Significant reduction from baseline, p < 0.05. ΔSUV – change in maximum SUV after neoadjuvant chemotherapy

RESULTS

- SUV_{max} decreased in 53/55 (96%)
 - Increased in 1 OS in femur, 1 EwS in humerus
- Osteosarcoma:**
 - Mean decline of 5.6g/ml (57%; p < 0.0001)
 - Declines correlated to Huvos grade (Table 2)
 - Largest decline with Huvos IV
 - Non-metastasized OS: ΔSUV_{max} predictive of length of survival (β = 6.7, 95% CI 0.9–12.5) when controlled for necrosis
 - Metastatic OS: SUV not predictive of survival
 - Huvos grade was significant only in univariate regression
- Ewing sarcoma:**
 - SUV metrics did not distinguish patients who did and did not achieve 100% after NAC

DISCUSSION

- This study is the first to demonstrate a correlation between SUV_{max} and Huvos grading in OS, offering a potential surrogate to estimating histologic necrosis prior to surgical resection
- Change in SUV_{max} positively correlated to length of survival in non-metastatic OS
- Similar trends were not seen in metastatic OS or EwS group, reflecting metastasis as the overriding prognostic factor in these groups



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