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Research Article

# RETROSPECTIVE STUDY OF MYELOID SARCOMA FROM TERTIARY CARE CENTRE OF WESTERN INDIA

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**ABSTRACT**

**Objective:** Hematological malignancies may present as extramedullary malignant myeloid precursor cell mass in rare cases. Myeloid sarcoma (MS) may associated with acute or chronic leukemia. To discuss clinicopathologicalfeatures and treatment response of myeloid sarcoma(MS) patients at our institute.
**Methods:** We described the clinicopathologicalfeatures and treatment response of 31 MS patients in the Medical oncology department of Gujarat cancer research institute, ahemdabad, Gujarat, india from January 2010 to december 2015 and the relevant literature. MS patients were treated with systemic chemotherapy using Acute myeloid leukemia (AML)-like regimens only or local treatment (radiation, surgery) with or without systemicchemotherapy using AML-like regimens.
**Results:** In this study 31 patients aged 6-68years (median: 32years; mean: 35.8years). There were 15 male and 16 female with a ratio of 0.9:1. The MS occurrence was most common at the lymphnodes (N=7, 22.6%), followed by Bones (N=5, 16.13%) and orbit (N=5, 16.13%) and reproductive organs (N=3, 9.70%). The MS of 5 patients (16.13%) were associated with AML, 5 (16.13%) patients were associated with CML and 21(67.74%) patients had de novo isolated MS. Twelve patients (38.71%) were treated with surgery and/or radiotherapy, chemotherapy (SRC) and nineteen (61.29%) with chemotherapy (C). Sixteen patients (51.61%) achieved a complete remission (CR), ten (32.26%) achieved a partial remission(PR), and five(16.13%) had progression. After treatment, the number of patients who achieved a CR was lower in the C group (N=8, 42.11%) than in the SRC group (N=8, 66.67) (P =0.035). On follow-up, two patients in the SRC group and four in the C group died (P =0.72). Survival for SRC and C treatment group was 83.3% and 78.9% respectively (P=0.0328) and 36 months in both groups.
**Conclusion:** The combined application of histopathology, immunohistochemistry and imaging are required to diagnose MS. Induction chemotherapy or tyrosine kinase inhibitor (imatinib) administered as early as possible. Surgery and/or radiotherapy administered to symptomatic lesions or tumors causing organ obstruction. Prospective controlled trials are required to describe characteristics of MS and role of targeted treatment.



## INTRODUCTION

Extramedullary primitive myeloid masses of hematolymphoid malignancy are rare neoplasm difficult to diagnose and treat. Myeloid sarcomas (MSs) occur in isolation, or with acute myeloid leukemia (AML), myeloproliferativeneoplasm (MPN), myelodysplastic syndrome (MDS) or chronic myeloid leukemia (CML).[1]. MS may occured 2.5–9.1% of acute myeloid leukemia (AML) patients. Isolated MS is a rare entity reported in 2 cases per million adults.[3] Knowledge of MS is largely based on retrospective studies and case reports. Myeloid sarcoma (MS) was first described by Burns in 1811, later King was reported as “a green colored tumour” “chloroma” in 1853. Rappaport described the term “granulocytic sarcoma” in 1966. Myeloid sarcoma term was reported by World Health Organization (WHO) in 2002.[2]. Isolated MS can occur at any age from pediatric to elderly patients.The common sites of MS diagnosis are lymph nodes, orbit, bone, testes, gastrointestinal tract, and peritoneum.[4]. The European Society for Hematology classified a variety of extramedullary manifestations of myeloid neoplasms:(1) MS with concurrent AML; (2) extramedullary relapse of AML, including inthe post bone marrow transplant setting; (3) blast phase/transformation of a myeloproliferative neoplasm or chronic myelomonocyticleukemia; and (4) isolated MS, which occurs in association with a normal bone marrow biopsy and blood film, and in the absence of any history of myeloid neoplasia[1]. MS may express myeloid or myelomonocytic markers such as CD13, CD33, myeloperoxidase (MPO), CD14, CD64, CD68, CD117, CD34, lysozyme, CD43, CD163, etc.[1]. The median survival of MS patients is 12.8 months and patients classified in to groups according survival good (OS >30 months: reproductive and digestive systems), intermediate (OS 15–30 months: head/neck, skin/breast and kidney/ bladder/ retroperitoneum/adrenal) and poor (OS <15 months: nervous system, connective/soft tissue, lymph nodes/spleen, cardiac/mediastinal and bones/joints). [5]. We retrospectively analyzed the clinicopathological and treatment outcome of 31 patients with MS to facilitate the diagnosis and treatment of this rare malignancy.

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## MATERIALS AND METHODS

We retrospectively studied the clinicopathological and treatment outcome of 31 MS patients in the Medical oncology department of Gujarat cancer research institute, ahemdabad, Gujarat, india from January 2010 to december 2015. All patients' medical data collected from the hospital quality control electronic records were consecutively selected to investigate the clinical and pathological presentations, including age, gender, past history, physical examination, laboratory studies, treatment, and outcomes from January 2010 to december 2015. Primary outcome was treatment outcome. Secondary outcomes included overall survival (OS). Immunohistochemical analysis was performed on tumour cells by administering antibodies against myeloperoxidase (MPO), lysozyme, leukocyte common antigen (LCA), terminal-deoxynucleotidyltransferase (TdT), CD3, CD4, CD30, CD43, CD56, CD68, CD79a, CD99, and B-cell lymphoma-2 (BCL-2) to diagnose MS. Cells were considered positive for each marker if the marker was expressed by at least 20% of the neoplastic cells. BM biopsy and aspirate with karyotype and gene rearrangement analysis were performed to rule out other hematologic malignancies. We performed fluorescence in situ hybridization (FISH) and other molecular studies on histological specimen and BM cells for detection of MS and AML or CML. Complete remission (CR) for MS was defined as complete disappearance of all detectable clinical and radiographic evidence of disease and disappearance of all disease-related symptoms. Partial remission (PR) was defined as a reduction equal or more than 50% of the sum of the products of the greatest diameters of bidimensionally measurable lesions.

### *Imaging analysis*

Multiple modalities such as CT scan in the axial plane by using a helical CT scanner with 16 slice after the intravenous administration of iodinated contrast material and MRI with a 3-Tesla magnetic field were performed. (Figure 1a,b,c,d)

### *Statistical analysis*

Statistical analysis was performed using descriptive statistics SPSS version 21, P -value < 0.05 was defined as statistically significant for each analysis and Kaplan-Meier method was used for calculating the survival. Informed consent was obtained from all patients or their relatives and institutional ethical committee approved retrospective study.

***Ethics:*** The waiver for informed consent was obtained from the Ethics Committee of Gujarat cancer and research institute due to the retrospective nature of the study on 26/10/2021.The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1964, as revised in 2013.

## RESULTS

The clinical symptoms and anatomical location of thirty one patients at the time of MS diagnosis are shown in Table 1. There were 15(48.4%) male and 16(51.6%) female, with a ratio of 0.9:1) aged 6-68years(median: 32years;mean:35.8 years),with 77.42% (24) patients in the 19–64 years age group,16.13% (5) patients in pediatric age and 6.45% (2) patients in elderly age group. The common site of MS occurrence was the Lymphnodes (N=7, 22.6%), followed by Bones (N=5, 16.13%) and orbit (N=5, 16.13%) , breast(N=2, 6.45%), and Reproductive organs (N=3, 9.70%). The MS of 5 patients (16.13%) were associated with AML, 5 (16.13%) patients were associated with CML and 21(67.74%) patients had de novo isolated MS.

The presenting symptoms such as multiple swellings of lymphnodes, Back pain /lower limb weakness, tingling and numbness, bladder and bowel incontinence, chest pain, abdominal pain, proptosis, painful mass and nasal blockage were related to the primary site of MS. Myeloid origin cells showed variable expression of MPO(90%), lysozyme, LCA,CD43, CD56, CD68, CD79a, CD99, and BCL-2 on immunohistochemical staining (Figure 2a,b,c,d). AML and CML was diagnosed with immunophenotyping of BM cells. (Table 2).Cytogenetic of BM cells revealed a normal karyotype (NK) in 26 evaluable patient including 5AML patients while the philadelphia chromosome (translocation 9; 22) in 4 CML-CP patients. In one CML-blast crisis karyotype showed47 chromosomes with trisomy of chromosome 8, monosomy of chromosome 18 and double Philadelphia chromosome in 2 metaphases and three metaphases shows t(9;22). Fish for BCR-ABL fusion were detected in 5 patients.

**Table 1** Anatomical locations and clinical symptoms in 31 patients.

| Anatomic locations | Number | % | Clinical manifestations |
|---|---|---|---|
| Lymph nodes | 7 | 22.60 | Multiple superficial swelling of lymph nodes |
| Bones and joints (Vertebrae, scapula, fibula, skull) | 5 | 16.13 | Back pain /lower limb weakness, tingling and numbness, bladder and bowel incontinence. |
| Breast | 2 | 6.45 | Breast lump |
| Mediastinum | 2 | 6.45 | Cough, breathlessness, chest pain |
| Reproductive organs (cervix, uterus, ovary, vault) | 3 | 9.70 | Abdominal pain, vaginal bleeding and menstrual disorders. |
| Testicle | 1 | 3.22 | Presented with scrotal swelling |
| Gastrointestinal tract (oesophagus) | 1 | 3.22 | Difficulty in swallowing |
| Lung | 1 | 3.22 | Breathlessness, cough |
| Nasal passages and oropharynx, Tonsil | 1 | 3.22 | Nasal airway blockage; nasal bleeding, |
| | 1 | 3.22 | Pain while swallowing |
| Orbit | 5 | 16.13 | Swelling, dimness of vision |
| Muscle (gluteal muscle) | 1 | 3.22 | Buttock mass |
| Central nervous system (thalamus) | 1 | 3.22 | Headache, lump and vomiting |

Multiple anatomical locations were found in 14 patients.

MS lesions (N=28, 90.3%) were shown as discrete solid masses with variable enhancement on both CT and MRI.MS in lymphnodes showed few nodes in level IA, b/l level IB, II and III in neck, preparatracheal region, precarinal, subcarinalregion, b/l axilla, paripancreatic region, b/l external iliac vessels, b/l inguinal regions and Hepato-splenomegalyon CT neck, thorax and abdomen. Orbit MS showed presence of altered signal intensity lesion is noted in extraconal compartment along right lateral rectus muscleon MRI orbit & brain. A spinal MS lesion found in the epidural and prevertebral area was iso-intense on T1- weighted images and had intermedial signal intensity on T2-weighted images on MRI spine.(Figure 1a,b,c,d).

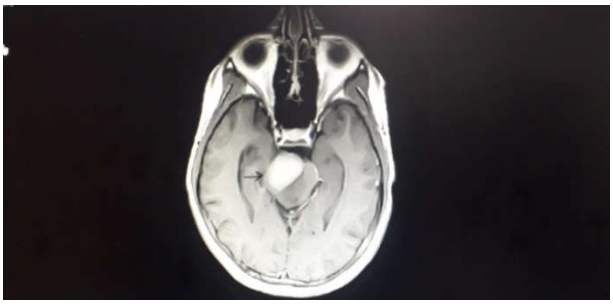


**Figure 1a**

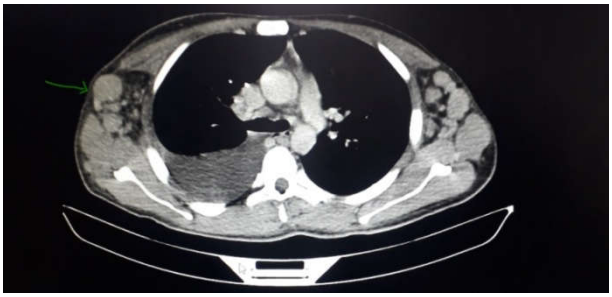


**Figure 1b**

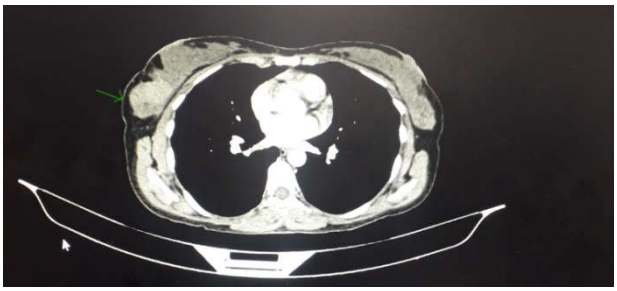


**Figure 1c**

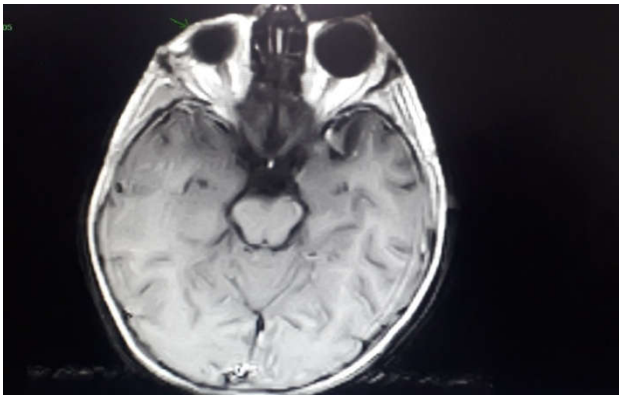


**Figure 1d**

Figure 1a: MRI brain showed lesion involving the right globus pallidus, right internal capsule and right caudate nucleus. Figure 1b:CTthorax showed few lymphnodes in b/l axilla. Figure 1c CT thorax showed homogenously enhancing well-defined soft tissue density lesion is involving breast. Figure 1d MRI head showed Presence of ill-defined extraocular altered signal intensity area is noted in extraconal and intraconal compartment in orbit.

Myeloid cells at various stages of maturation exhibit either granulocytic or monocytic maturation on histopathology specimen. Immunohistochemistry, flow cytometry, fluorescence in situ hybridization (FISH), and other molecular techniques differenciate diagnosis and prognosis . (Figure 2a, 2b, 2c, 2d, 2e, 2f)

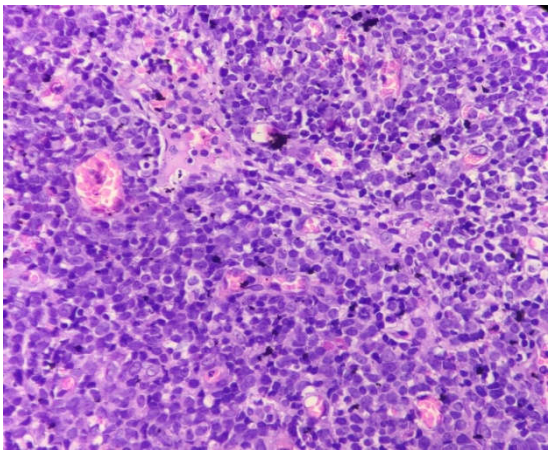


**Figure 2a**

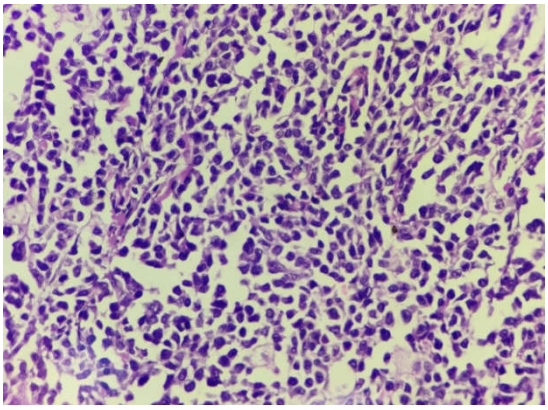


**Figure 2b**

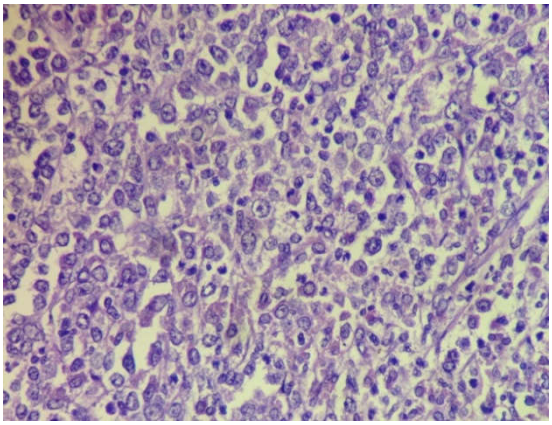


**Figure 2c**

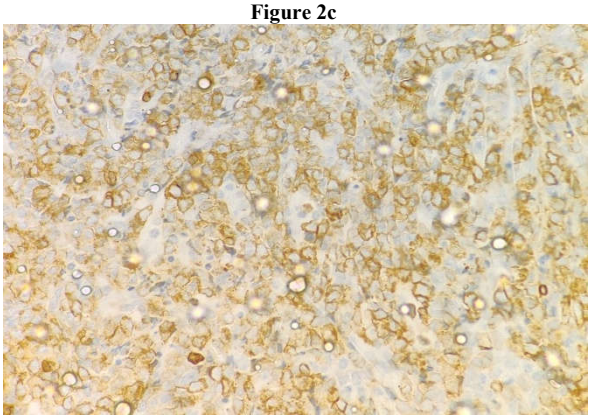


**Figure 2d**

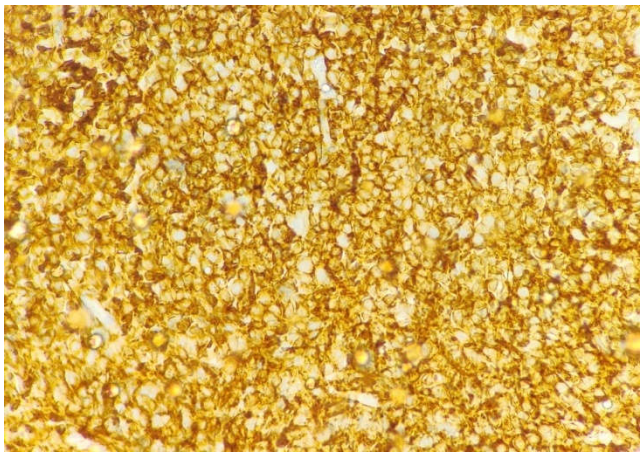


**Figure 2e**

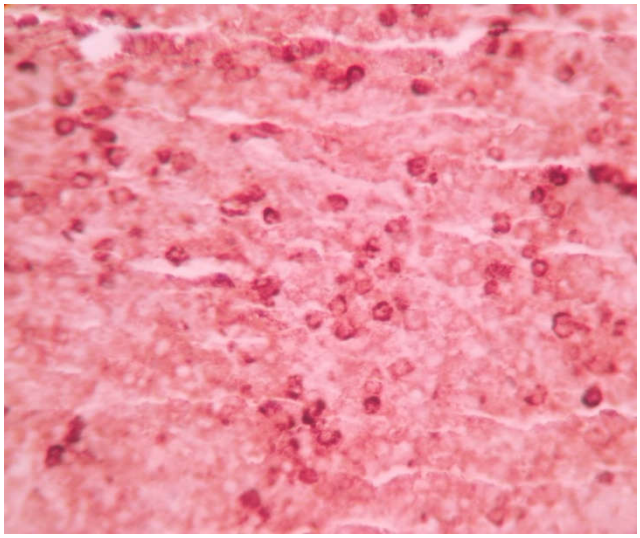
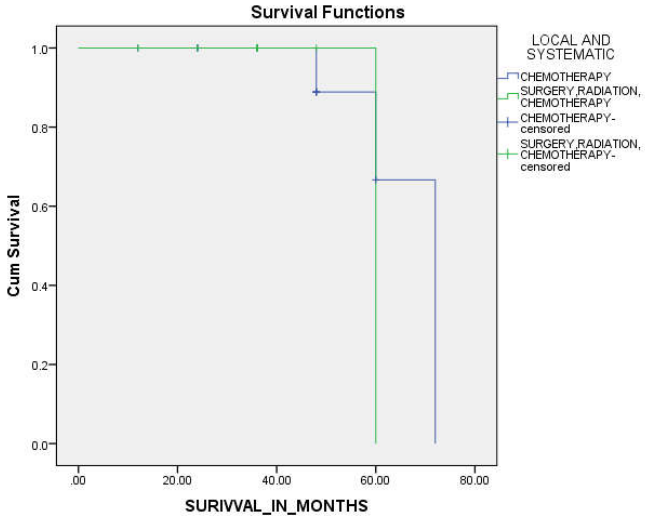


**Figure 2f**

Figure 2a: MS of breast, Figure 2b: MS of lymphnode, Figure 2c: MS of spine, Figure 2d:LCA positive, Figure 2e CD 117 positive, Figure 2f :MPO positive.

MS patients were treated with surgery, radiation and chemotherapy to induce remission. Patients were divided into 2 groups according to treatment. Twelve patients (C group, 38.71%) were treated with chemotherapy and nineteen (SRC group, 61.29%) with surgery, radiation and chemotherapy. 16 patients (51.61%) achieved a CR, 10 (32.26%) achieved a PR, and 5(16.13%) had progression after first line treatment. The median time from diagnosis to the first CR was 3.2 months (range, 0.2–6.6 mo). The MS of 5 patients (16.13%) associated with AML and 5 patients (16.13%) associated with CML (Table 2).

In the C group median age 37 years greater than that in the SRC group 35 years (P =0.027). There were 9 male and 10 female (ratio 0.9:1) in C group and 6 male and 6 female in SRC group (ratio 1:1). In the SRC group number of orbit and bones MS patients (N=5, 58.33%) were greater than in the C group (N=5, 26.32%). Number of lesions between the 2 groups were not statistical significant.(P =0.054).




**Graph 1** Survival for SRC and C treatment groups.

**Table 2** The clinicopathological and treatment outcome of MS patients divided into C and SRC treatment strategies

| Characteristics | Chemotherapy treatment only (N=19) | Surgery+Radiation treatment±chemotherapy treatment (N=12) | P |
|---|---|---|---|
| Age, median (range), yr | 37 (6-67) | 35 (8-68) | 0.027 |
| Gender, N (%)Male/female | 9 (47.36) / 10 (52.64) | 6(50.0)/6(50.0) | 0.675 |
| White blood cells, $\times 10^9$/L, median (range) | 7.70 (2.9-387) | 9.20 (4.5-126.60) | 0.018 |
| Hemoglobin, g/L, median (range) | 10.40 (6.5-15.2) | 10.6 (7.80-14.70) | 0.067 |
| Platelet, $\times 10^9$/L, median (range) | 315 (12-398) | 386.50 (222-715) | 0.027 |
| LDH level, N (%)WNR/ANR | 8 (42.11) / 11(57.89) | 3(25.0)/9(75.0) | 0.039 |
| Primary involved site, N (%) | 19 (100) | 12(100) | |
| Lymphnodes (N=7, 22.58%), | 6 (31.58) | 1 (8.33) | |
| Bones (N=5, 16.13%) | 2 (10.53) | 3 (25) | - |
| orbit (N=5, 16.13%) | 3 (15.79) | 2 (16.67) | |
| Reproductive organs (N=3,9.68%). | 2 (10.53) | 1 (8.33) | |
| Others(N=11,35.48) | 6 (31.58) | 5 (41.67) | |
| Number of lesions, N (%) Solitary/multiple | 9 (47.37) / 10 (52.63) | 9(75.0)/3(25.0) | 0.054 |
| Cytogenetics, N (%) Normal/philadelphia chromosome | 16(84.21 )/ 3(15.79) | 10(83.33)/2(16.67) | 0.048 |
| Chemotherapy regimen (N=31), N (%) 7+3/Tyrosine kinase inhibitor (Imatinib) | 16(84.21 )/ 3(15.79) | 11(91.67)/1(8.33) | 0.058 |
| Radiotherapy dose, gray, median (range) | 0 | 20(20-30) | - |
| Treatment outcome, N (%)CR/non-CR | 8 (42.11)/11(57.89) | 8(66.67)/4(33.33) | 0.035 |
| Associated to AML/CML, N (%) | 06 (31.58)/ 13(68.42) | 3(25.0)/9(75.0) | 0.053 |
| Survival, N (%) Alive/death | 15(78.95)/4(21.05) | 10(83.33)/2(16.67) | 0.0328 |
| Cause of death, Disease progression, infection N (%) | 3 (15.79 )/1(5.26) | 1(8.33)/1(8.33) | 0.72 |
| Survival, months, median (range) | 36 (12-72) | 36 (12-60) | 0.006 |

Abbreviations: CR, complete remission; LDH, lactatedehydrogenase, ANR, above normal range.

Number of patients who achieved a CR were lower in the C group (N=8 ,42.11%)than in the SRC group (N=8,66.67 %)(P =0.035) SRC group had statistically significant higher CR than C group. In the SRC group two patients and C group four patients were died on follow up (P =0.72). All patients regularly followed up for 12 to 72 months, six patients (19.35%) died due to disease progression and infection but not related to treatment (Table 2). Survival for SRC and C treatment group using kaplan-meier was 83.3% and 78.9% respectively (P=0.0328) and 36 months in both groups.(Graph 1). Local and systematic treatment had stastistically significant increased survival than systemetic treatment.

## DISCUSSION

We analysed clinicopathological characteristics and treatment outcome of MS patients treated in the Medical oncology department of Gujarat cancer research institute, ahemdabad, Gujarat, india from January 2010 to december 2015 and the relevant literature. MS is a rare hematolymphoid malignancy composed of the myeloid immature cells series. MS is difficult to diagnose thus incidence rate of disease is unknown. MS diagnosed in 2 out of 1,000,000 adults and 0.7 out of 1,000,000 children [6]. The age-adjusted incidence rate of isolated MS is 0.9% with a median age of 59 years [7]. Swerdlow SH *et al* study, MS is associated with or without AML/CML, male were more affected and median age of 56 years (range, 1 mo–89 yr) [8]. In our study female gender is predominance (51.6%) and median age of 35.8 (6-68 years).

Meis *et al* found 75% misdiagnosis rate. More recent series reported 25% to 47% misdiagnosis rate and cases were wrongly diagnosed as Ewing sarcoma, poorly differenciated carcinoma, thymoma, hodgkin lymphoma, histiocytic lymphoma, large-cell lymphoma, melanoma, round blue cell tumors.[9] In pathological assessment of specimens, immunohistochemical analysis is mandatory with morphological diagnosis to differentiate lymphomas or non-hematopoietic tumours from MS. In our study, LCA, CD68, MPO, lysozymes etc myeloid markers and CD34, CD30, CD4 cell surface markers with TdT, and glycophorin A are stained during immunohistochemical analysis. TdT, and glycophorin A for diagnosis of MS.[10] Myeloperoxidase (MPO) staining was used to differentiate lymphoma from MS. MS expressed 66% to 96% MPO cause green colour on air exposure, leading to name “chloroma.”[11]

In Shinagare AB *et al* and Noh BW *et al* studies, CT scan showed iso-dense or hyper-dense signals relative to brain or muscle of MS lesions and MRI showed heterogeneously iso-intense or hyper-intense signals on T2-weighted MRI and hypo-intense or iso-intense signals on T1-weighted MRI. [12-13].

In our study, CT and MRI for MS lesions were similar to previous study. MRI of SpinalMS, thalamus MS and orbital MS were largely mildly hyper-intense to muscle on T2-weighted MRI and iso-intense on T1-weighted MRI. CT scan of lymphnodes, uterus, ovary, testis, mediastinum and esophagus MS were largely iso-dense to muscle.

Several studies were conducted to detect poor prognostic factors in MS. In Pileri *et al* showed that tumor location, age ,morphological classification or presentation with or without concomitant AML were neither influenced disease course nor response to therapy in 92 MS patients.[14]. Another studies showed that systemic chemotherapy, age younger than 47.5 years and a favorable karyotype were associated with a lower risk of death on multivariate analysis.[15] In our study showed that younger age, normal wbc count, normal platelet count, normal LDH, favourable cytogenetic associated with higher CR rate and better survival. Yamauchi and Yasuda *et al* reported that 19% patients who received surgery plus chemotherapy versus 5% patients who did not receive any systemic treatment had nonleukaemic period of 2 months. 81% of patients treated by surgery alone progressed to AML within 11 months of diagnosis.[16] Surgical debulking or excision should be considered important in symptomatic MS patients due to mass effect of lesion before the initiation of systemic treatment.[17]Radiation treatment can give excellent, durable local control at lesion site; however, alone radiotherapy was given inadequate treatment response unless combined with chemotherapy.[18] Recurrence rate was lower in chemoradiotherapy group than radiotherapy alone treated 21 isolated MS patients.[19] Surgery or radiation alone are considered ineffective to prevent transformation from MS to AML and improve prognosis without chemotherapy.[20] AML induction chemotherapy have been used to treat MS patients, including daunorubicin and cytarabine, fludarabine, cytarabine, idarubicin, and granulocyte colony-stimulating factor (G-CSF) (FLAG); idarubicin and cytarabine; cyclophosphamide, cytarabine, topotecan, and G-CSF (CAT-G) which achieve complete remission in 65% of MS patients and reported median survival of 40 months.[16,21] There is unique and rare association of MS with CML-CP 0r CML-BC. Tyrosinekinase inhibitor (TKI) imatinib treatment improved overall survival of medullary blast phase (BP) and chronic phase of CML patients. [22]. In literature, chemotherapy regimens comparision to treat MS patients are very limited. In our study, 12 patients (38.71%) treated with surgery or radition local with systemic chemotherapy (Table 2). In SRC group, 8(66.7%) patients achieved CR with median survival 36 months. These src group patients were characterized by MS involvement in the orbit, thalamus and vertebral body at the time of diagnosis.In contrast, 19 patients (61.29%) treated with chemotherapy treatment and achieved 8(42.11%) CR with median survival 36 months in C group. MS involvement of lymphnodes, reproductive organ, breast and mediastinum were included in C group patients. Limitations of study is small sample size and database did not have details of patients who had progressive disease whether they recieved any treatment or not. In future Prospective study will define standard treatment regimen and novel targeted therapy.

## CONCLUSION

Hematolymphoid malignancies rarely manifest as MS, commonly associated with AML. MS can develop in any part of body including lymphatic system, bone, skin, reproductive organ, orbit, breast. The clinicopathological and treatment response of patient sample was analyzed retrospectively in this study. Prospective multinational studies are neccessory to indetify the characteristics of MS and novel treatment regimens.

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**Authors’Conflicts of Interest**

All authors’ reported no potential conflicts of interest in this article.

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