Effects of Autoimmune Disorders on Myelodysplastic Syndrome Outcomes: A Systematic Review

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Abstract: Background: Autoimmune disorders (ADs) are prevalent among patients with myelodysplastic syndrome (MDS), yet their impact on MDS outcomes, including overall survival (OS), mortality, and transformation to acute myeloid leukemia (AML), is not well defined. Methods: We conducted a systematic review of articles published up to April 2024, sourced from PubMed, Web of Science, Embase, and Google Scholar, focusing on the influence of ADs on survival and AML transformation rates in MDS patients. The methodological quality of each study was assessed using the Newcastle Ottawa Scale. Results: From 8 studies that met the inclusion criteria, ADs were present in 17.5% (3074/17,481) of MDS patients. Data analysis indicated mortality rates ranging from 15.3% to 67% in MDS patients with ADs and 12% to 69% in those without. The rate of AML transformation varied from 0% to 23% in patients with ADs compared to 4% to 30% in those without. Conclusions: The influence of ADs on survival and AML transformation in MDS patients appears variable. This systematic review highlights the need for further large-scale prospective studies to clarify the relationship between ADs and MDS outcomes.

Keywords: autoimmune disorders (ADs); myelodysplastic syndrome (MDS); overall survival (OS); acute myeloid leukemia (AML) transformation; survival outcomes; mortality; prognosis; systematic review

1. Introduction

Myelodysplastic syndrome (MDS) is a clonal hematopoietic stem cell condition marked by cytopenia, unusual cellular structure, and impaired hematopoiesis. The prevalence of this disease varies by geographical region, with around 10,000 people diagnosed with MDS each year in the United States alone [1]. Furthermore, it is more common in men, Caucasians, and the older population [1,2]. Over the last two decades, major efforts have been undertaken to study the diversity and complexity of the pathogenesis of this disease, culminating in the identification of dysfunctional epigenetic mechanisms and genetic defects in several pathways. However, despite this enormous progress, the clinical and prognostic implications of certain pathogenic pathways in MDS remain unclear.

Autoimmune disorders (ADs) typically impact around 3 to 10% of the world’s population and can occasionally lead to morbidity and mortality incidences comparable to those seen in cancer and cardiac illnesses [3,4]. Furthermore, AD and MDS can occur concurrently, with research reporting that about 10–30% of MDS patients develop ADs [5–7].
These ADs may include neutrophilic dermatosis (ND), Systemic lupus erythematosus (SLE), rheumatoid arthritis (RA), vasculitis, relapsing polychondritis, Behcet disease (BD), inflammatory bowel disease, and Crohn’s disease, which is the most frequent [8,9]. The diagnosis period for ADs and MDS can vary due to the diverse clinical development of these conditions. Research has shown that although an AD is rarely the initial presentation, MDS can develop many months to years after the onset of the AD [10], and this time gap is much longer if the AD has been present for ten or more years [11]. Under different situations, these illnesses can be diagnosed concurrently. However, in the majority of scenarios, MDS typically serves as the first manifestation, with the reported median duration between the diagnosis of MDS and the subsequent diagnosis of an AD being approximately 8 months [5].

Although MDS and ADs coexist, it remains uncertain whether one illness has a partial role in triggering the onset of the other. In instances when an AD is the first diagnosis, vulnerability to MDS seems to be associated with poor immune surveillance. Indeed, research has suggested that MDS formation in ADs can stem from chronic immunologic imbalance with persistent immune activation generating bone marrow lesions or infiltration [9,10]. However, in this aspect, drug etiology is widely embraced, with data suggesting that MDS might be a treatment-related myeloid neoplasm that occurs as a consequence of postponed management of ADs [9]. On the other hand, in settings where MDS characterizes the initial presentation, ADs are believed to originate from MDS-related immune dysregulation disorders [12]. Therefore, a defective tolerance, including cellular and humoral immunity, may be related to diminished anti-tumor responses that might culminate in the formation of autoreactive cells, thus weakening immune regulation. Moreover, increased production of cytokine—specifically interleukin-1 and -6 and tumor necrosis factor (TNF) by malignant monocytes, principally in chronic myelomonocytic leukemia or from the lymphocytes being part of the abnormal dysplastic clone—has also been reported [13]. However, more research is needed to fully grasp the precise process that causes ADs in patients with MDS. Finally, shared genetic susceptibilities and trigger factors between the diseases have been found in the context of concurrent MDS and ADs [9,14]. Moreover, environmental factors such as exposure to tobacco are also understood to be risk factors for the simultaneous development of MDS and ADs [15,16].

While the above overview suggests that MDS and ADs can coexist, the heterogeneity of ADs makes it challenging to understand their effects on MDS patients. Therefore, the current systematic review has investigated the impact of ADs on the survival and rate of acute myeloid leukemia (AML) transformation in patients with MDS.

2. Materials and Methods
2.1. Information Sources and Literature Search

The current study was conducted according to the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines. The PubMed, Web of Science, Embase, and Google Scholar databases were extensively searched for articles published until April 2024. The database search combined keywords such as myelodysplastic syndrome, autoimmune diseases, survival, and acute myeloid leukemia using the Boolean expressions ‘AND’ and ‘OR’ to form definitive search strings. Furthermore, more articles were obtained by scrutinizing the reference lists of articles relevant to our research objective. Duplicate papers and grey literature containing unpublished data were excluded since they would have undercut the current study’s scientific purpose and jeopardized the statistical analysis. The search strategy employed in each electronic database is detailed in the appendix section (Appendix A).

2.2. Eligibility Criteria

Two reviewers independently screened the full-text records obtained from the electronic databases and included those focusing on the impact of ADs on MDS. Furthermore, studies had to have reported outcomes such as overall survival, mortality, rate of AML.
transformation, and median survival. Moreover, studies had to be published in English to be considered for inclusion. Studies designed as case reports, editorials, ongoing clinical trials, letters to the editor, narrative reviews, and meta-analyses were excluded. Additionally, studies reporting the risk of developing MDS in AD patients and vice versa were excluded. All discrepancies during the selection process were resolved by consulting a third reviewer.

2.3. Data Extraction and Data Items

Two independent reviewers screened the eligible studies and extracted the data required to conduct a comprehensive review and analysis. The information collected by these reviewers included study details (surname of the primary author, study design, study location, and MDS subtype), pertinent characteristics of the study population (sample size, gender distribution, and mean/median age), MDS stages categorized using the International Prognostic Scoring System (IPSS) or the Revised IPSS (IPSS-R), follow-up duration, and the reported outcomes. All inconsistencies during the data extraction were resolved by constructive discussion between the two reviewers or by consulting a third reviewer.

The primary outcomes analyzed in the current review article were overall survival (OS), mortality, and rate of AML transformation. OS was defined as the duration from the diagnosis of MDS until death resulting from any cause or end of follow-up.

2.4. Quality Appraisal

The quality of each included study was assessed using the Newcastle Ottawa Scale (NOS). This quality appraisal tool assessed studies based on the selection, comparability, and outcome domains. Under the selection domain, a maximum of four stars could be awarded for representativeness of the exposed cohort, selection of the nonexposed cohort, ascertainment of exposure, and demonstration that the outcome of interest was not present at the beginning of the study. A maximum of two stars was awarded in the comparability domain based on the confounders adjusted for design or analysis. Finally, a maximum of three stars was assigned under the outcome domain for the assessment of outcome, whether follow-up was long enough for outcomes to occur, and the adequacy of the follow-up for cohorts. Furthermore, the overall methodological quality was categorized as poor (NOS score: 0–3), fair (NOS score: 4–6), or good (NOS score: 7–9).

2.5. Synthesis of Results

Due to the high clinical heterogeneity of the studies, regarding the outcomes and sample sizes of the study participants, a quantitative summary (i.e., meta-analysis) of the results was not conducted. Therefore, we conducted a qualitative and narrative synthesis of the results. These results are presented and discussed depending on the reported outcomes. The first discussion is on the impact of ADs on MDS survival, of which data regarding OS and mortality are presented. The second discussion is on the impact of ADs on the rate of AML transformation.

3. Results

3.1. Study Selection

The database search identified 1559 articles with predefined MesH phrases. A thorough inspection of these articles led to the elimination of 761 records considered exact duplicates. The titles and abstracts of the remaining 798 records were screened, of which 512 deemed irrelevant to our study objective were excluded. Of the remaining 286 records, 253 were disqualified before screening for eligibility because they were case reports, editorials, letters to the editor, narrative reviews, or meta-analyses. Finally, eight studies were used for review and analysis after an in-depth screening process and eligibility evaluation. The other 25 records were excluded due to the following reasons: 5 were authored in different languages, 11 reported the risk of developing ADs in MDS patients, and 9 reported the risk of developing MDS in AD patients. The full selection criteria are outlined in Figure 1.
The present review article included eight studies published between 2004 and 2023. Seven of these studies were retrospective, and one was prospective. Furthermore, these studies were performed in medical institutions from different geographical locations (Japan, the United States, France, Spain, the United Kingdom, and Greece). The eight studies enrolled 17,481 patients with MDS, of which 3074 (17.5%) had ADs (Table 1).
Table 1. Study Characteristics.

<table>
<thead>
<tr>
<th>Study ID</th>
<th>Study Design</th>
<th>Study Location</th>
<th>Sample (n)</th>
<th>M/F</th>
<th>Age (Years)</th>
<th>M/F</th>
<th>Age (Year)</th>
<th>MDS with AD</th>
<th>MDS without AD</th>
<th>MDS Stages (n)</th>
<th>Follow-Up (Range)</th>
<th>Outcomes</th>
<th>Mortality Rate (%)</th>
<th>AML Transformation Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrianzen-Herrera et al., 2023 [17]</td>
<td>Retrospective cohort study</td>
<td>United States</td>
<td>15,227</td>
<td>1111/1331</td>
<td>81 (77–86)</td>
<td>7080/5705</td>
<td>82 (77–87)</td>
<td>NR</td>
<td>NR</td>
<td>Low (165) High/intermediate (48)</td>
<td>19 months (5.7–44.3)</td>
<td>0.89 (0.85–0.94)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Montoro et al., 2018 [18]</td>
<td>Retrospective cohort study</td>
<td>Spain</td>
<td>142</td>
<td>35/33</td>
<td>77 (44–95)</td>
<td>54/20</td>
<td>76 (24–90)</td>
<td>NR</td>
<td>NR</td>
<td>Low (74) Intermediate—1 and 2 (106) High (17)</td>
<td>15.2 months (0.1–69.5)</td>
<td>2.75 (1.26–6.11)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Seguer et al., 2019 [19]</td>
<td>Retrospective case–control study</td>
<td>France</td>
<td>216</td>
<td>51/38</td>
<td>68.9</td>
<td>86/41</td>
<td>69.9</td>
<td>NR</td>
<td>NR</td>
<td>Low (268) Intermediate—1 and 2 (937) High (104)</td>
<td>15.2 months (68–78)</td>
<td>0.78 (0.66–0.92)</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Komrokji et al., 2016 [20]</td>
<td>Retrospective cohort study</td>
<td>United Kingdom</td>
<td>1408</td>
<td>219/172</td>
<td>NR</td>
<td>712/305</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>Low (64) Intermediate—1 (46) High and intermediate—2 (15)</td>
<td>NR</td>
<td>3.24 (1.03–10.23)</td>
<td>41.7</td>
<td>16.3</td>
</tr>
<tr>
<td>Arinobu et al., 2021 [21]</td>
<td>Retrospective cohort study</td>
<td>Japan</td>
<td>81</td>
<td>9/3</td>
<td>62.9 (52.3–73.6)</td>
<td>34/15</td>
<td>62.4 (58.6–66.2)</td>
<td>NR</td>
<td>NR</td>
<td>Low (64) Intermediate—1 and 2 (73) High (94)</td>
<td>NR</td>
<td>67</td>
<td>69</td>
<td>17.4</td>
</tr>
<tr>
<td>De Hollanda et al., 2011 [22]</td>
<td>Retrospective cohort study</td>
<td>France</td>
<td>235</td>
<td>25/21</td>
<td>78 (68–93)</td>
<td>87/102</td>
<td>81 (65–89)</td>
<td>NR</td>
<td>NR</td>
<td>Low (32) Intermediate (10) High (28)</td>
<td>4 years</td>
<td>15.3</td>
<td>12.3</td>
<td>NR</td>
</tr>
<tr>
<td>Giannouli et al., 2004 [23]</td>
<td>Prospective cohort study</td>
<td>Greece</td>
<td>70</td>
<td>7/6</td>
<td>67 (51–80)</td>
<td>31/26</td>
<td>74 (43–89)</td>
<td>NR</td>
<td>NR</td>
<td>Low (5) Low (28) Intermediate (18) High (18) Very High (30)</td>
<td>NR</td>
<td>NR</td>
<td>46</td>
<td>20</td>
</tr>
</tbody>
</table>

Note: AD: autoimmune disorder; MDS: myelodysplastic syndrome; NR: not reported; OS: overall survival; AML: acute myeloid leukemia.
3.2. Quality Appraisal Outcomes

Table 2 shows the results of the quality appraisal using the Newcastle Ottawa Scale. From the assessment, we found that three studies had good methodological quality and five had fair methodological quality; therefore, the risk of bias from these studies was minimal. Furthermore, most studies could not attain the maximum score under the selection domain because they had small sample sizes (i.e., less than 1000) or were carried out in single medical centers. Moreover, under the comparison domain only three studies were unable to attain maximum scores because outcomes such as OS were not adjusted for the main confounders, which were age and sex. Finally, none of the studies attained maximum scores under the outcome domain because there was no information given about the follow-up duration and how the outcomes were assessed.

3.3. Clinical Outcomes of MDS Based on the Presence of ADs

The impact of ADs on the OS of patients with MDS was addressed in five retrospective studies. Two of these studies showed that MDS patients with ADs had inferior OS compared to those without ADs [18,21]. In contrast, the other two studies reported that ADs were associated with a considerable decrease in mortality risk [17,20]. Moreover, another study reported that OS was better when ADs were diagnosed simultaneously with MDS or after the MDS diagnosis (HR: 0.1; \( p = 0.008 \) and HR: 0.024; \( p = 0.009 \)) [19].

Regarding mortality, six of the included studies suggest that the mortality incidence in MDS patients with ADs ranges from 15.3 to 67%, while the incidence for patients without ADs is about 12–69% [18,19,21–24]. Moreover, the qualitative review of data from four studies suggests that the rate of AML transformation is around 0–23% in MDS patients with ADs and 4–30% for patients without ADs [19–22].
<table>
<thead>
<tr>
<th>Study ID</th>
<th>Exposed Cohort Representativeness</th>
<th>Nonexposed Cohort Selection</th>
<th>Exposure Verification</th>
<th>Initial Outcome Absence</th>
<th>Cohort Comparability (Design/Analysis Adjusted for Confounders)</th>
<th>Outcome Evaluation</th>
<th>Sufficient Follow-Up</th>
<th>Cohort Follow-Up</th>
<th>Total Score</th>
<th>Overall Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrianzen-Herrera et al., 2023 [17]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>Good</td>
</tr>
<tr>
<td>Montoro et al., 2018 [18]</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>Good</td>
</tr>
<tr>
<td>Segueir et al., 2019 [19]</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>Fair</td>
</tr>
<tr>
<td>Komrokji et al., 2016 [20]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td>Good</td>
</tr>
<tr>
<td>Arinobu et al., 2021 [21]</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>6</td>
<td>Fair</td>
</tr>
<tr>
<td>De Hollandia et al., 2011 [22]</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>Fair</td>
</tr>
<tr>
<td>Giannouli et al., 2004 [23]</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>Fair</td>
</tr>
<tr>
<td>Takeoka et al., 2014 [24]</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>Fair</td>
</tr>
</tbody>
</table>
4. Discussion

Although ADs are common in MDS patients, their prognostic effect on MDS remains unclear. Therefore, the current systematic review investigated the impact of ADs on the OS, mortality, and rate of AML transformation in MDS patients.

4.1. Impact of ADs on the Survival of MDS Patients

Ascertaining the prognostic effect of ADs in MDS patients can be complicated given the inherent complexity and multifactorial nature of MDS and ADs. However, the current systematic review identified five studies reporting the prognostic significance of ADs in MDS patients. This association was mostly achieved by comparing the survival outcomes and mortality incidences in MDS patients with or without ADs. For instance, a retrospective study of 1408 MDS patients reported that patients with MDS with ADs achieved significantly better OS than those without ADs after adjusting for covariates such as age and R-IPSS (Revised International Prognostic Scoring System) classification [20]. This finding compares favorably with another retrospective study of 15,227 patients, which reported that the risk of death decreased by 11% in MDS patients with ADs after controlling for covariates such as age, sex, rural residence, immunosuppressive therapy, higher MDS histologic risk, and transfusion dependence [17]. Although the exact reason for this positive association between ADs and survival remains unknown, it might be attributed to the fact that ADs have a neutral or protective role in the later stages of MDS when genetic mutations and clonal evolution are the underlying drivers of the disease.

In contrast, other studies have shown a negative association between ADs and the survival outcomes of MDS patients. For instance, Montoro and colleagues found that the presence of ADs among MDS patients was associated with a poor prognosis [18]. Remarkably, even after categorizing patients according to the R-IPSS, low-risk MDS patients with ADs still demonstrated poorer OS than patients without ADs (75% vs. 94%, respectively; \( p = 0.06 \)). This negative effect was associated with poor baseline characteristics such as low levels of hemoglobin among MDS patients with ADs. Similarly, a retrospective study of 61 MDS patients found that the 5-year OS was considerably worse among patients with ADs as opposed to those without ADs (44.2% vs. 74.6%). Moreover, the univariate and multivariate analyses in that study suggested that the presence of ADs was an independent factor for mortality [21].

Interestingly, there is evidence suggesting that certain autoimmune disorders can have distinctive survival outcomes in MDS patients. Lee and colleagues found that although no considerable difference in OS was observed between MDS patients with and without ADs, those with neutrophilic dermatosis (ND)—a group of skin disorders characterized by an infiltration of neutrophils (a type of white blood cell) into the skin without evidence of infection, often associated with underlying systemic diseases such as inflammatory bowel disease, rheumatoid arthritis, hematologic malignancies, and other systemic inflammatory conditions—demonstrated significantly higher rates of death (\( p = 0.003 \)). Furthermore, after adjusting for age, sex, and IPSS, ND was found to be an independent factor for higher risk of mortality (HR: 1.788; \( p = 0.038 \)) [25]. This poor survival rate among MDS patients with ND was attributed to the fact that ND was related to a complex karyotype associated with 5q deletion, which has been reported to increase mortality in previous studies [26,27]. On the other hand, Segueir and colleagues carried out a univariate analysis using vasculitis as the reference and found that none of the other ADs, including polyarthritis, cutaneous manifestations, immune cytopenia, and relapsing polychondritis, was associated with the OS of MDS patients [19].

Similar to OS, mortality incidence was highly variable across the included studies. For instance, Arinobu and colleagues found that the mortality incidence was considerably higher in patients with ADs [21]. In these patients, the major causes of death were interstitial pneumonitis, MDS, graft-versus-host disease (GVHD), and congestive heart failure. On the other hand, the major causes of mortality in patients without ADs were MDS, pneumonia, AML, GVHD, cutaneous infection, and acute coronary syndrome. Similarly, Montoro
and colleagues reported significantly higher incidences of mortality in MDS patients with ADs compared to those without ADs (OR: 3.23; \( p = 0.008 \)) [18]. In contrast, De Hollanda and colleagues recorded almost similar incidences of mortality between MDS patients with and without ADs (67% vs. 69%, respectively) [22]. Similarly, Segueir et al. recorded statistically equal mortality incidences between patients with and without ADs (40.9% vs. 52%; \( p = 0.13 \)) [19].

It is clear that the evidence provided above on the effect of ADs on MDS survival is highly conflicting. Moreover, most of the evidence was outsourced from retrospective data, which have inferior levels of evidence compared to prospective studies. Therefore, further research in large-sample prospective studies is required to establish the exact effect of ADs on MDS survival.

### 4.2. Impact of ADs on the Rate of AML Transformation

Approximately 40% of patients with high-risk MDS can experience deterioration or evolution to AML [28,29]. Furthermore, MDS patients who progress to AML are at a higher risk of death than those who do not [30]. Therefore, it is vital to assess the impact of ADs on the rate of AML transformation in MDS patients as it may help to improve the survival of these patients.

In the current review, we have observed conflicting evidence regarding the association between ADs and the rate of AML transformation. For instance, Seguier and colleagues reported a considerably higher incidence of AML transformation in MDS patients without ADs compared to those with ADs (\( p = 0.03 \)) [19]. This positive effect of ADs was also observed in the study by Komrokji et al. [20]. A possible explanation for the reduced risk of AML observed in these studies is that they mostly included low-risk patients, i.e., those with an IPSS of very low, low, and intermediate. Conversely, a 2022 study of 13,344 non-high-risk MDS patients reported that the presence of ADs was linked to 18% increased odds of AML transformation [31]. Furthermore, the risk for AML transformation was greater in intermediate-risk patients than in low-risk patients. Similarly, Takeoka and colleagues reported that the rate of MDS patients progressing to AML was two times higher in those with ADs than without [24]. Although the exact reason for this variation between studies is unclear, it might be due to the clinical heterogeneity of ADs. Since ADs are highly variable, each type of AD might have a different effect on the rate of AML transformation. This is evident in the study by de Hollanda et al. [22], where four MDS patients with systemic vasculitis progressed to AML after a mean duration of 6 months, suggesting that systemic vasculitis might be a factor of poor prognosis and AML transformation.

### 4.3. Limitations

The current study has several limitations that should be acknowledged while interpreting its findings. First, most of the included studies were retrospective in nature, and the data were obtained from small sample sizes; thus, findings from these studies were susceptible to biases. Second, our eligibility criteria only allowed us to review data from studies published in English, meaning that the current study was subject to selection bias. Finally, due to high clinical heterogeneity we could not carry out any meta-analyses. Therefore, all information provided in this study was based on a qualitative review of the data. The clinical heterogeneity can be associated with the variation in follow-up duration, sample sizes, and MDS stages across the studies.

### 5. Conclusions

Although ADs are common manifestations in MDS patients, their impact on survival and rate of AML transformation is highly inconsistent. This inconsistency may be due to the fact that MDS and ADs are a group of diseases rather than individual diseases. Furthermore, most of the studies reviewed had small sample sizes, and the follow-up duration and MDS stages were highly variable, making the prognosis of MDS with ADs a debatable matter. Therefore, further investigation in large-sample prospective studies is
required to fully understand the association between MDS and ADs, especially in this era where new therapies targeting the immune system have been made available for patients with MDS.


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**Data Availability Statement:** No new data were created or analyzed in this study. Data sharing is not applicable to this article.

**Conflicts of Interest:** The authors declare no conflicts of interest.

**Appendix A**

**Search Strategy**

**PubMed**

[All fields] (Autoimmune disorders OR Autoimmunity OR Autoimmune diseases OR Autoimmunity OR Autoimmune phenomena OR Autoimmune manifestations OR immunologic abnormalities OR immune-related disorders OR Immune manifestations OR Autoimmune conditions) AND (Myelodysplastic syndrome OR Dysmyelopoietic Syndrome OR Hematopoietic Myelodysplasia OR MDS OR Myelodysplasia).

[Titles/Abstract] (Autoimmune disorders OR Autoimmunity OR Autoimmune diseases OR Autoimmunity OR Autoimmune phenomena OR Autoimmune manifestations OR immunologic abnormalities OR immune-related disorders OR Immune manifestations OR Autoimmune conditions) AND (Myelodysplastic syndrome OR Dysmyelopoietic Syndrome OR Hematopoietic Myelodysplasia OR MDS OR Myelodysplasia) AND (Survival OR mortality OR Death OR Overall survival OR Acute myeloid leukemia transformation OR Rate of AML evolution OR Rate of AML progression).

**Google Scholar**

(with all of the words) (Autoimmune disorders OR Autoimmunity OR Autoimmune diseases OR Autoimmunity OR Autoimmune phenomena OR Autoimmune manifestations OR immunologic abnormalities OR immune-related disorders OR Immune manifestations OR Autoimmune conditions) AND (Myelodysplastic syndrome OR Dysmyelopoietic Syndrome OR Hematopoietic Myelodysplasia OR MDS OR Myelodysplasia).

[With at least one of the words] (Survival OR mortality OR Death OR Overall survival OR Acute myeloid leukemia transformation OR Rate of AML evolution OR Rate of AML progression).

**Web of Science**

(Autoimmune disorders OR Autoimmunity OR Autoimmune diseases OR Autoimmunity OR Autoimmune phenomena OR Autoimmune manifestations OR immunologic abnormalities OR immune-related disorders OR Immune manifestations OR Autoimmune conditions) AND (Myelodysplastic syndrome OR Dysmyelopoietic Syndrome OR Hematopoietic Myelodysplasia OR MDS OR Myelodysplasia) AND (Survival OR mortality OR Death OR Overall survival OR Acute myeloid leukemia transformation OR Rate of AML evolution OR Rate of AML progression).

**Embase**

(Autoimmune disorders OR Autoimmunity OR Autoimmune diseases OR Autoimmunity OR Autoimmune phenomena OR Autoimmune manifestations OR immunologic abnormalities OR immune-related disorders OR Immune manifestations OR Autoimmune conditions) AND (Myelodysplastic syndrome OR Dysmyelopoietic Syndrome OR Hematopoietic Myelodysplasia OR MDS OR Myelodysplasia) AND (Survival OR mortality OR Death OR Overall survival OR Acute myeloid leukemia transformation OR Rate of AML evolution OR Rate of AML progression).
abnormalities OR immune-related disorders OR Immune manifestations OR Autoimmune conditions) AND (Myelodysplastic syndrome OR Dysmyelopoietic Syndrome OR Hematopoietic Myelodysplasia OR MDS OR Myelodysplasia) AND (Survival OR mortality OR Death OR Overall survival OR Acute myeloid leukemia transformation OR Rate of AML evolution OR Rate of AML progression).

References


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