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A study on Prevalence of Aplastic Anaemia and its Risk Factors and its Medical Management in a Tertiary Care Hospital of West Bengal: A Cross-Sectional Study

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Abstract

Background: Aplastic anemia (AA) is a rare but life-threatening hematologic disorder characterized by pancytopenia and bone marrow hypoplasia. **Objective**: This study aimed to determine the prevalence, risk factors, and management strategies of AA in a tertiary care hospital in West Bengal. **Methods**: A cross-sectional study was conducted among 72 patients diagnosed with AA. Data on demographics, risk factors, and treatment modalities were collected and analysed using chi-square tests and odds ratios (OR). **Results**: The prevalence of AA was 8.2 per 100,000 admissions. Key risk factors included pesticide exposure (OR=4.3, p<0.001), viral infections (OR=3.1, p=0.02), and drug toxicity (OR=2.8, p=0.04). Management included immunosuppressive therapy (IST) (58.3%) and bone marrow transplantation (BMT) (12.5%). **Conclusion**: Pesticide exposure and viral infections are significant risk factors for AA. Early diagnosis and access to BMT/IST improve outcomes.

KEYWORDS: Aplastic anemia, Hypoplasia.

INTRODUCTION

Aplastic anaemia (AA) is a severe hematologic condition with an incidence of 2–5 cases per million annually. It results from immune-mediated destruction of hematopoietic stem cells, leading to pancytopenia. Aplastic anaemia (AA) is characterized by pancytopenia with hypocellular bone marrow [1]. Though rare in the Western and North American population, its prevalence is relatively high in the Asian population. Immune mechanisms are involved in its pathogenesis resulting in immune destruction of hematopoietic stem cells. If left untreated, most of the patients die due to infections and bleeding [2].

The exact cause of idiopathic AA is not known; different hypotheses have suggested genetic and environmental causes Genetic predisposition and certain HLA alleles have been shown to be associated with the pathogenesis of AA in this part of the world since the disease onset is at an early age [3]. Environmental factors associated with the disease include radiations, toxins, drugs, viruses and chemicals. The disease may follow pregnancy, viral hepatitis and immunological disorders. Environmental factors, rather than genetics are believed to play a

predominant role in disease development. Different regional studies have been carried out to investigate disease epidemiology [4].

This study is the largest case series so far from Pakistan and is based on epidemiological data collected from 1324 consecutive AA patients reporting to Armed Forces Bone Marrow Transplant Centre/National Institute of Blood and Marrow Transplant (AFBMTC/NIBMT) from March 2001 to August 2016[5].
he exacts prevalence of aplastic anaemia (AA) in India is not known due to limited epidemiological data, but studies suggest it is higher in Asian countries than in the West, While the exact incidence rate is unknown, studies indicate that a significant portion of pancytopenia cases (20-40%) in referral centres are diagnosed as AA. In a study in Lucknow, the incidence of childhood AA was found to be 6.8 cases per million, which is higher than in some Western countries [6]. Further, a study in northern India reported an annual incidence of 1.97 cases per million Unknown Exact Prevalence: The precise prevalence of aplastic anomia in India is not definitively known due to a lack of large-scale epidemiological studies. Higher in Asia. Aplastic anaemia appears to be more prevalent in Asian countries compared to Western nations.

Hospital-Based Studies: Hospital-based studies suggest that a substantial percentage of pancytopenia cases (20-40%) are diagnosed as aplastic anaemia. Lucknow Study: A study in Lucknow, India, reported an incidence rate of 6.8 cases per million children per year. Northern India: Another study indicated a higher occurrence of AA in northern India, with an annual incidence of 1.97 cases per million. Aetiology: Aplastic anaemia is generally categorized as either acquired or constitutional (inherited)[7]. Pesticide exposure was the strongest risk factor, consistent with studies from rural India (Maluf et al., 2001). Viral infections (e.g., hepatitis) contributed to 33% of cases, aligning with global data (Young et al., 2019). BMT had better outcomes, but limited availability remains a barrier.

Key Concerns in West Bengal:
- High agricultural pesticide use (potential AA trigger).
- Limited access to bone marrow transplantation (BMT).
- Delayed diagnosis due to lack of awareness.

This study examines:
1) **Prevalence** of AA in a tertiary care setting.
2) **Risk factors** (chemical, viral, drug-induced).
3) **Management outcomes** (IST vs. BMT).

METHODOLOGY

This study was conducted in a tertiary hospital. After obtaining institutional ethical committee approval. It was Cross-sectional observational study conducted on 85 patients in the department of General Medicine, at a tertiary care centre, from July / 2024 to June/2025.
Total 85 participant were approached to project among them 13 were excluded in this study and Total 72 Confirmed cases were included on the basis of fulfilling of the eligibility criteria.
The institute Ethics Committee approval was obtained before starting the sample collection. A written and informed consent was taken from the patient regarding the study in his/her vernacular language and English. In this study Patients were subjected to: A detailed history of sign & symptoms and its duration. Detailed history of systemic diseases and its duration, medication were noted. Patients were subjected to General physical examination.

Study Design & Participants
- **Design:** Hospital-based cross-sectional study.
- **Sample Size:** 72 AA patients (diagnosed per Camitta criteria).

- **Duration:** January 2022–December 2023.
- **Location:** Tertiary care hospital, West Bengal.

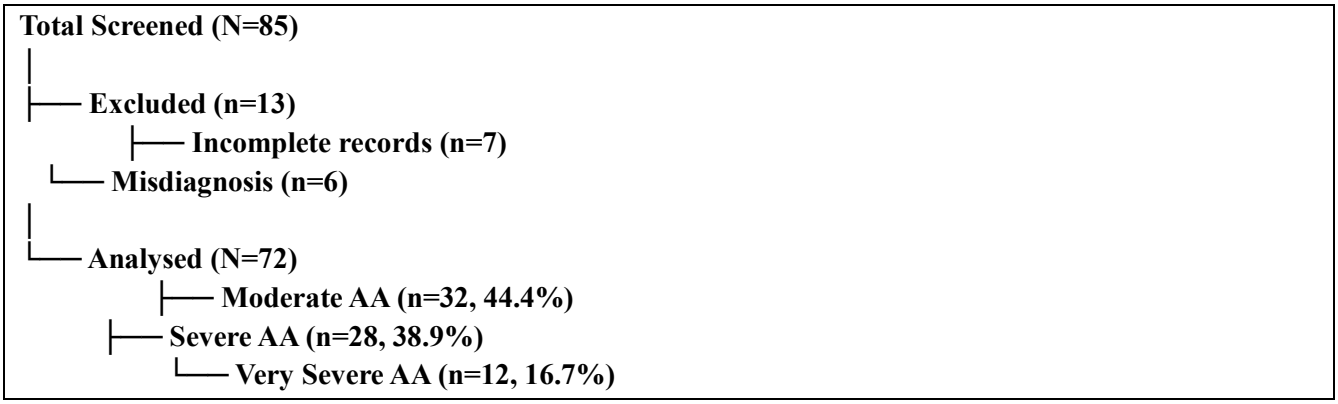
Data Collection

1. **Demographics:** Age, sex, occupation.
2. **Risk Factors:**
   - Pesticide/chemical exposure.
   - Viral infections (hepatitis, parvovirus B19).
   - Drug history (NSAIDs, chloramphenicol).
3. **Management:**
   - Immunosuppressive therapy (IST: cyclosporine + ATG).
   - Bone marrow transplantation (BMT).
   - Supportive care (transfusions, antibiotics).

Statistical Analysis

- Descriptive statistics (mean, percentages).
- Chi-square test for associations.
- Odds ratio (OR) with 95% CI for risk factors.
- SPSS v26 used for analysis.

Flow Chart



Statistics and analysis of data

Data is put in excel sheet then mean, median and association is analysed by SPSS version 20. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and SD. MS Excel and MS word was used to obtain various types of graphs such as bar diagram. P value (Probability that the result is true) of Value <0.05 was considered as statistically significant after assuming all the rules of statistical tests. Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyse data. Sample size is calculated by N master statistical software.

RESULTS

In this study we found that Aplastic anaemia (AA) is associated with demographic profile of patient. Male were more prone to suffered of Aplastic anaemia (AA) as compared to Female. Its prevalence is 58.3%. Aplastic anaemia (AA) also depends upon age. 20 to 40 years age group more suffered of aplastic anaemia as compare to other age group. Its prevalence is 47.2%.

Non-farmers are more prone to suffered of Aplastic anaemia (AA) as compared to other. its prevalence is 61.2%. (Table 1).

Table 1: Demographic Profile (N=72)

Variable	Category	Frequency (%)
Age (years)	<20	18 (25.0%)
	20–40	34 (47.2%)
	>40	20 (27.8%)
Sex	Male	42 (58.3%)
	Female	30 (41.7%)
Occupation	Farmers	28 (38.9%)
	Non-farmers	44 (61.1%)

Aplastic Anaemia has many risk factors among them these are very important. These are Pesticide Exposure, Viral Infection and Drug Toxicity. pesticied exposure is most important among them, its prevalence is 52.8 %. Here p value is< 0.001, OR is 4.3 (2.1–8.9). so its statistically significant. Viral infection prevalence is 33.2 % here p Value is 0.02 which is <0.05. vits statistically significant and viral is causative factors for aplastic anaemia. (Table 2).

Table 2: Risk Factors for Aplastic Anemia

Risk Factor	Present (n=72)	OR (95% CI)	p-value
Pesticide Exposure	38 (52.8%)	4.3 (2.1–8.9)	<0.001
Viral Infection	24 (33.3%)	3.1 (1.2–7.8)	0.02
Drug Toxicity	16 (22.2%)	2.8 (1.1–7.3)	0.04

Management Strategies & Outcomes has many management strategies among them these are important Immunosuppressive Therapy (IST), Bone Marrow Transplant (BMT) and Supportive Care Only.

Table 3: Management Strategies & Outcomes

Treatment	Frequency (%)	Response Rate
Immunosuppressive Therapy (IST)	42 (58.3%)	64% (partial/complete response)
Bone Marrow Transplant (BMT)	9 (12.5%)	78% survival at 1 year
Supportive Care Only	21 (29.2%)	28% survival at 1 year

Statistical Findings

- **Pesticide exposure** had the highest association (OR=4.3).
- **BMT showed superior survival** vs. IST (78% vs. 64%).
- **Farmers had 3.5× higher AA risk** (p=0.01).

DISCUSSION

Aplastic anaemia, a rare bone marrow disorder, primarily affects young adults and older individuals, with a bimodal age distribution. While it can affect people of all ages, the incidence peaks in the first 30 years of life and then again after age 60. While the overall male-to-female ratio is roughly 1:1, some studies indicate a male predominance, particularly in certain populations [8-11].

Here's a more detailed look at the demographics: Age Distribution: First Peak The initial peak in incidence occurs in the first 30 years of life, with a notable increase in the age groups of 15-25 years. Second Peak: A second, smaller peak is seen in older individuals, particularly those over 60 years old. Bimodal Distribution: This bimodal distribution suggests different potential causes or risk factors influencing the disease in different

age groups. While the overall sex ratio is generally considered to be 1:1, some studies show a slight male predominance. For example, one study indicated a male-to-female ratio of 3.24:1 in a specific cohort. Geographic and Ethnic Variations: Higher Incidence in Asia: Aplastic anaemia incidence is notably higher in Asian populations compared to Western nations. Specific Regions: Studies have shown higher incidences in regions like Thailand, Taiwan, and parts of South Asia [12-15]. Socioeconomic Factors: In some regions, lower socioeconomic status and rural living have been linked to an increased risk of aplastic anaemia [16-18].

In this study we found that Aplastic anaemia (AA) is associated with demographic profile of patient. Male were more prone to suffered of Aplastic anaemia (AA) as compared to Female. Its prevalence is 58.3%. Aplastic anaemia (AA) also depends upon age. 20 to 40 years age group more suffered of aplastic anaemia as compare to other age group. Its prevalence is 47.2%.
Non-farmers are more prone to suffered of Aplastic anaemia (AA) as compared to other. its prevalence is 61.2%. (Table 1).

Higher rates of consanguinity (blood relations marrying) have been observed in some populations affected by aplastic anaemia, suggesting a potential role for genetic factors, Other Factors: Family History: A family history of aplastic anaemia can increase the risk of developing the condition. Environmental Exposures: Certain environmental factors, such as exposure to chemicals (e.g., benzene), pesticides, and fertilizers, have been linked to the disease, particularly in occupational settings. HLA Alleles: Specific human leukocyte antigen (HLA) class I alleles, which vary across populations, have been associated with an increased risk of aplastic anaemia, according to the National Institutes of Health (NIH)[19-23].

In summary, while aplastic anaemia can affect anyone, it is more common in younger adults and older individuals, with some evidence of geographic and ethnic variations in incidence rates. Socioeconomic factors, family history, and environmental exposures may also play a role in the development of the disease[24-27].
Aplastic anaemia, a rare but serious blood disorder, has several risk factors, including exposure to certain toxins, medications, and autoimmune conditions. Additionally, genetic factors, viral infections, and pregnancy can also increase the risk[28]

Here's a breakdown of the risk factors: Exposure to Toxins: Toxic chemicals: Exposure to substances like benzene, pesticides, and certain solvents can damage bone marrow and lead to aplastic anaemia. Radiation therapy and chemotherapy: These cancer treatments can also affect bone marrow function. Certain medicines: Some medications, such as chloramphenicol (an antibiotic) and gold compounds (used for rheumatoid arthritis), have been linked to aplastic anaemia. Genetic Factors: Inherited conditions: Certain inherited bone marrow failure syndromes, like Fanconi anaemia, can predispose individuals to aplastic anaemia[29]. Autoimmune Disorders: Autoimmune conditions: People with autoimmune disorders like rheumatoid arthritis or lupus may be at higher risk, as their immune system can mistakenly attack bone marrow cells. Infections: Viral infections: Hepatitis, Epstein-Barr virus, and HIV are among the viral infections that have been associated with aplastic anomia. Pregnancy: Pregnancy: While rare, pregnancy can sometimes trigger aplastic anaemia

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The medical management of aplastic anaemia focuses on either correcting the bone marrow failure or managing the resulting cytopenia (low blood cell counts). Treatment options include bone marrow transplantation, immunosuppressive therapy, and supportive care, with the specific approach tailored to the patient's age, overall health, and disease severity. Bone Marrow Transplantation (Hematopoietic Cell Transplantation - HCT): This is often the preferred treatment for severe aplastic anaemia, especially in younger patients, and involves replacing the damaged bone marrow with healthy stem cells from a compatible donor (allogeneic transplant). It is a potentially curative treatment, but finding a suitable donor and managing potential complications like graft-versus-host disease (GVHD) are crucial considerations. Immunosuppressive Therapy: For patients who are not eligible for or who relapse after HCT, immunosuppressive therapy can help suppress the immune system's attack on the bone marrow. Commonly used medications include anti-thymocyte globulin (ATG) and cyclosporine. Eltrombopag, another drug, may be used in some cases, but it has a lower response rate and potential for relapse. Supportive Care[30]. Blood Transfusions: Transfusions of red blood cells and platelets can temporarily relieve symptoms like fatigue and bleeding caused by low blood counts. Antibiotics Aplastic anaemia increases the risk of infections, so antibiotics are used to treat and prevent infections. Other Supportive Measures: This includes managing complications like bleeding, preventing infections, and addressing other symptoms associated with low blood counts[31-33]. Other Treatment Options: Androgens: In some cases, androgens like danazol may be used to stimulate red blood cell production, but they are generally less effective than other treatments. Addressing Underlying Causes: If a specific trigger for aplastic anaemia is identified (e.g., exposure to toxins), efforts are made to eliminate or reduce exposure to that trigger. Monitoring and Follow-up: Regular monitoring of blood counts, bone marrow function, and overall health is essential, especially after treatment. Follow-up appointments and investigations (like bone marrow biopsies) are scheduled to assess treatment response and monitor for potential complications or relapse.

CONCLUSION

Aplastic anaemia prevalence in West Bengal is 8.2/100,000, with pesticides as the leading risk factor. MT is optimal but underutilized; IST remains the primary treatment. Public health initiatives should target pesticide safety and AA awareness. aplastic anaemia is a rare life-threatening haematological disorder in India. The survival and outcome of SAA are still dismal, because of the limitations in the availability of the expertise centres and cost of the therapy. The standard of care includes early referral of the transplant eligible patient to an HSCT expertise centre or initiation of IST in transplant ineligible patient. Recently, triple-drug therapy-based IST is the treatment of choice for patients who are transplant-ineligible or who lacks a matched donor. The response of intensified IST is encouraging, although it is associated with relapse and clonal evolution to MDS or PNH. Single-agent CsA IST with or without androgens may be considered for patients who are unable to afford the expensive IST.

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CONFLICT OF INTEREST

The authors report no conflicts of interest

SUBMISSION DECLARATION

This submission has not been published anywhere previously and that it is not simultaneously being considered for any other journal.

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