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# *Letter to Editor: Recent Advancement in Blood Cancer Research and Management*

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## Letter to Editor

Blood Cancer is one of the leading causes of death globally. As per National Foundation for Cancer Research 1.2 million people in the U.S alone is living with blood cancer [1]. According to the statistical data provided by Leukemia & Lymphoma Society every 3 minutes a new person is diagnosed with some type of blood cancer [2]. Adding to the complexity of the disease there is no accurate survival data available. Generally, blood cancers are of three distinct types affecting the leucocyte cells (Leukemia), lymphocytes (Lymphoma) and plasma cells like B lymphocytes (Myeloma). These are further sub-classified according to severity and effected cells. Recent advancements in diagnostic technique have significantly increased the survival rate.

Early diagnosis and staging of the disease play a pivotal role in blood cancer management and treatment strategies. Conventional methods include blood test, Bone marrow examination, Diagnostic imaging tests-CT scan, PET scan, and X-ray, Physical examination, Surgical lymph node removal (for examination).

**Table 1:** Diagnostic technique for different types of blood cancers.

| Blood cancer sub-type | Diagnostic technique |
|---|---|
| *Acute myeloid leukemia* | Immunophenotyping, cytogenetics, molecular testing, Analysis of FLT3, NPM1, and CEBPA, Analysis of PML-RARA |
| *Chronic myelogenous leukemia* | Cytogenetics, by FISH, or by PCR targeted at the BCR/ABL fusion gene. |
| *Acute lymphoblastic leukemia* | Immunophenotyping, bone marrow examination |
| *Chronic lymphocytic leukemia* | smears of the peripheral blood and bone marrow, immunophenotyping, ZAP-70 analysis, and ($IgV_H$) gene mutation status |
| *Polycythemia vera* | Molecular testing on a peripheral blood or bone marrow sample for JAK2 V617F mutation |
| *Essential thrombocythemia* | Molecular testing on a peripheral blood or bone marrow sample for JAK2 V617F mutation |
| *Primary myelofibrosis* | Molecular testing on a peripheral blood or bone marrow sample for JAK2 V617F mutation |
| *Myelodysplastic syndromes* | cellularity, immunophenotyping, cytogenetics, and molecular studies |

Staging helps understand the exact type, location, and spread of the cancer and it usually goes hand in hand with diagnosis. However, there are different advanced techniques for the detection of sub-types of blood

cancers in a more accurate way. Table 1 summarizes the recent diagnostic methods for blood cancers [3]. In the recent past molecular level studies have gained pace. Many specific molecular markers are now known which helps in early detection of the disease. Some of specific molecular markers are listed in Table 2 [3]. However, many lymphomas have not yet been linked to any biomarker.

**Table 2:** Molecular markers for different types of blood cancers.

| Types of blood cancer | Detection of chromosome | Markers |
|---|---|---|
| Follicular lymphoma | t(14;18) | IgH/BCL2 |
| Mantle cell lymphoma | t(11;14) | IgH/CCND1 |
| Marginal zone lymphoma | t(11;18) | API/MALT1 |
| Burkitt lymphoma | t(8;14) or t(2;8) or t(8;22) | IgH/CMYC |
| Anaplastic large cell lymphoma | t(2;5) | NPM/ALK |

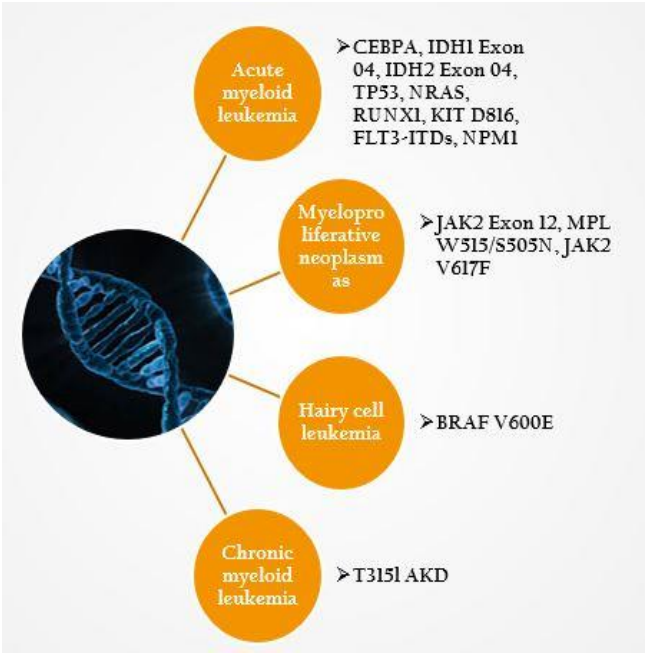


**Figure 1:** Genes associated with specific type of blood cancer.

Although there is no strong evidence of blood cancers being heritable in nature. Still several genes and their studies are being linked to specific type of blood cancers. They are now being exploited for molecular level diagnosis of the disease. Figure 1 shows different genes associated with specific type of blood cancer [3].

It is important that constant research should be performed to find novel ways for disease diagnosis and treatment. Although a number of conventional medication and treatment strategies is available in the market, many pharmaceutical companies are performing clinical trials and biomedical research in this regard. A number of drugs and biologicals have been approved by United Stated Food and Drug Administration (U.S.FDA) in the recent past. Table 3 summarizes the drugs approved by U.S.FDA in the last two years for blood cancers, the brand name, the company for which it has been approved and indication for medication [4].

**Table 3:** List of drugs approved by U.S.FDA for blood cancer in last two years.

| Drug | Brand Name | Company | Indication | Year |
|---|---|---|---|---|
| Moxetumomab pasudotox-tdfk | Lumoxiti | Astrazeneca Pharmaceuticals | Hairy cell leukemia | 2018 |
| Gemtuzumab ozogamicin | Mylotarg | Pfizer Inc | CD33-positive acute myeloid leukemia | 2017 |
| Ivosidenib | Tibsovo | Agios Pharmaceuticals | Relapsed or refractory acute myeloid leukemia | 2018 |
| Midostaurin | Rydapt | Novartis Pharmaceuticals Corporation | Acute myeloid leukemia with genetic mutation of FLT3 | 2017 |
| Daunorubicin and cytarabine | *Vyxeos* | Jazz Pharmaceuticals | Acute myelogenous leukemia | 2018 |

| | | | | |
|---|---|---|---|---|
| Glasdegib | Daurismo | Pfizer Inc | Newly diagnosed acute myeloid leukemia | 2018 |
| Gilteritinib | Xospata | Astellas Pharma | Acute myeloid leukemia (AML) with a FLT3 mutation | 2018 |
| Enasidenib | Idhifa | Celgene Corporation | Refractory acute myeloid leukemia | 2017 |
| Ivosidenib | Tibsovo | Agios Pharmaceuticals, Inc | Refractory acute myeloid leukemia | 2018 |
| Blinatumomab | Blincyto | Amgen Inc | B-cell precursor acute lymphoblastic leukemia | 2018 |
| Duvelisib | Copiktra | Verastem, Inc | Refractory chronic lymphocytic leukemia (CLL) or small lymphocytic lymphoma (SLL) | 2018 |
| Tisagenlecleucel | Kymriah | Novartis Pharmaceuticals Corporation | Young adult patients with a form of acute lymphoblastic leukemia | 2017 |
| Tagraxofusp-erzs | Elzonris | Stemline Therapeutics | Blastic plasmacytoid dendritic cell neoplasm | 2018 |
| Calaspargase pegol-mknl | Asparlas | Servier Pharmaceuticals LLC | Acute lymphoblastic leukemia | 2018 |
| Bosutinib | Bosulif | Pfizer Inc | Philadelphia chromosome positive (Ph+) chronic myelogenous leukemia | 2017 |
| Dasatinib | Sprycel | Bristol-Myers Squibb Co | Philadelphia chromosome-positive (Ph+) chronic myeloid leukemia (CML) | 2017 |
| Venetoclax | Venclexta | Abbvie Inc and Genentech Inc. | Chronic lymphocytic leukemia (CLL) or small lymphocytic lymphoma (SLL) | 2018 |
| Nilotinib | Tasigna | Novartis Pharmaceuticals Corporation | Philadelphia chromosome positive chronic myeloid leukemia | 2018 |
| Rituximab and hyaluronidase human | Rituxan hycela | Genentech Inc | Follicular lymphoma, diffuse large B-cell lymphoma, and chronic lymphocytic leukemia | 2017 |
| Inotuzumab ozogamicin | Besponsa | Wyeth Pharmaceuticals Inc., a subsidiary of Pfizer Inc | B-cell precursor acute lymphoblastic leukemia | 2017 |

From the patient's perspective, it is important that the financial burden of treatment must be minimized. In the coming years, we believe that more breakthrough researches will be made, and new and cost-effective way of treatment will be available for the masses.

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