



## Systematic Reviews

# Contribution of pioneer women hematologists in India in the 20<sup>th</sup> century

Kanjaksha Ghosh

National Institute of Immunohaematology, KEM Hospital, Mumbai, Maharashtra, India.

### \*Corresponding author:

Kanjaksha Ghosh,  
National Institute of  
Immunohaematology,  
KEM Hospital, Mumbai,  
Maharashtra, India.

[kanjakshaghosh@hotmail.com](mailto:kanjakshaghosh@hotmail.com)

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## ABSTRACT

**Purpose:** There is an increasing interest in the contribution of women in science and various branches of medicine. Hematology is a recently developed specialty. The purpose of this review was to explore the contribution of pioneer women hematologists of India in the last century when the subject was developing across the world including India.

**Methods:** PubMed database was searched up to 1999 with the following keywords – women, hematologist, hematopathologist, hemato-oncologist, and India. The Indian Journal of Hematology, Indian Journal of Pathology, Indian Journal of Pediatrics, National Medical Journal of India, and Indian Journal of Medical research were manually searched for hematology articles written by women hematologists before 1999. Authors own experience from the intimate knowledge in the field for more than 40 years helped in the search. Women involved purely in blood banking were not included in the study. So also, many women hematologists who grew up at the end of the 20<sup>th</sup> century and continued to contribute to the subject were not included as the pioneer hematologist.

**Results:** Between the 1930s and early 1950s, only one lady from the UK came and worked in nutritional hematology in India. Subsequently rose quite a few of them in that specialty mainly from major academic medical centers in India. Their teaching, research, and institution-building capability were exemplary.

**Conclusion:** Considering hematology and related specialty being a recently developing subject, the contribution of women hematologists as pioneers in the field is exemplary and worth emulating.

**Keywords:** Women hematologist, India, 20<sup>th</sup> century

## INTRODUCTION

Hematology is a relatively new specialty in medicine. Started as a hybrid approach between internal medicine and pathology, before the final look of the subject was established both pathologists and internal medicine experts continued to enrich the subject and handled patients in India. In addition, certain infections such as malaria and Kala-Azar were endemic in India and both the infections had substantial hematopathology in their etiopathogenesis. Experts in this area were also early contributors to the subject. Considering these facts and understanding that a substantial number of female medical graduates entering clinical practice is only a recent phenomenon, it will not be out of place to review the contribution of lady hematologists on the subject in the past century in India. A similar evaluation has been made for western lady hematologists relatively recently.<sup>[1]</sup>

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### LUCY WILLIS (1888–1964)

Lucy Willis was posted in Haffkine Institute, Mumbai, during the 1930s (1929–1935) as a part of the Indian Medical Service when she did a thorough investigation on nutritional macrocytic anemia and macrocytic anemia of pregnancy. At that time in the Western world, pernicious anemia was getting rapt attention. Castle has described intrinsic factors in the stomach; he also described an extrinsic factor in the liver extract which successfully treated pernicious anemia.

This extrinsic factor will, later on, be purified and concentrated in the bovine liver as Vitamin B12. Obviously at that time, these two varieties of anemia, that is, macrocytic anemia of pregnancy and nutritional macrocytic anemia were thought to be another clinical presentation of pernicious anemia. Lucy Willis conclusively showed that these diseases do respond to crude liver extract but not to refined liver extract which successfully treated pernicious anemia in the west.

She also showed yeast extract in the form of marmite successfully treat the condition which was not amenable to then known B1, B2, B3, and B4 (Adenine) vitamin therapy. She conducted studies on monkeys as an experimental animal to prove her hypothesis.<sup>[2]</sup> In a series of articles through both human and animal studies, she conclusively established the true nature of the disease.<sup>[2-6]</sup> Creating infection induced severe hemolysis by Bartonella infection combined with diet to create nutritional deficiency; she tried to develop a pernicious anemia (nutritional macrocytic anemia with component of hemolysis which was seen in pernicious anemia) model in albino rats.<sup>[7]</sup> From that angle, she was also one of India's first experimental hematologist. It may be noted unlike many of us she published a large body of her research in Indian journals.

Her study was funded by Lady Tata Research Fund and Indian Research Fund Association (forerunner of the present day Indian Council of Medical Research [ICMR]). Her study demonstrated existence of an unknown factor (vitamin) which cures these two diseases. This unknown factor will later on be discovered as folic acid by another Indian scientist Subbarow's whose team was working in the USA.<sup>[8]</sup> Thus, Lucy Willis pioneered the nutritional anemia as well as experimental hematology research in India.

### BETTY COWAN (1917–2006)

Betty Cowan joined Christian Medical College (CMC), Ludhiana, and worked there between 1958 and 1984 and retired as the head of that institution. She was interested in broad specialty of medicine specially community medicine and nutrition. As nutrition was and is still one of the major challenges in our country, so also nutritional anemia.

She studied both iron deficiency anemia and nutritional megaloblastic anemia with special reference to associated changes in gastric and intestinal mucosa in these disorders and studied whether the nutritional anemia *per se* causes chronic gastritis or intestinal absorptive and epithelial changes. Although she showed changes in the stomach and small intestine in these conditions, she could not establish that the iron/hematinic deficiency *per se* was responsible for such changes.<sup>[9-12]</sup> Later on in her carrier, her major interest shifted to pediatric nutrition and causes of malabsorption in Punjabis.<sup>[13]</sup> One of the interesting facts to note is that there was a big gap of almost more than 2 decades after Lucy Willis that we had in our country another woman pioneer worker in hematology.

### SUSHILA SWARUP MITRA (1924–2013)

Sushila Swarup Mitra represents one of the three women hematologists trained by J B Chatterjea of Calcutta School of Tropical Medicine, an acknowledged founder of the subject in India. The other two women hematologists were Sandhya Ghose and Manju Dattachaudhuri.

Dr. Mitra hailed from Jaipur in Rajasthan and completed her MBBS from lady Hardinge Medical College and then did her D. Phil in hematology from the School of Tropical Medicine, Kolkata. She headed the ICMR hematology unit after J. B Chatterjea passed away in 1972. Her publications spanning more than 3 decades involved hemoglobinopathies, red cell enzymopathies, the interaction between the two, nutritional anemia, and immunity.<sup>[14-24]</sup> She developed or modified some red cell enzyme detection and hemoglobin electrophoresis techniques.<sup>[25]</sup> Some of her more than 150 recorded publications are listed in the ensuing reference.<sup>[14-25]</sup> She was also one of the earliest investigators in the country to use immunophenotyping in acute leukemia.<sup>[26]</sup> She received several national awards including those from ICMR and went to Libya for some time after working with Ramkrishna Mission Seva Pratisthan Hospital, Kolkata after which she went to her home town, Jaipur and practiced medicine and hematology. She passed away in 2013.

### SANDHYA GHOSH (1931–2002)

Sandhya Ghosh was regarded as more of an Institution builder rather than a prolific hematology researcher. Yet during her acquiring a Ph.D. degree in hematology under Dr. J. B Chatterjea on the subject of acute and chronic myeloid leukemia, she published several research papers including the epidemiology of the disease in West Bengal.<sup>[27-32]</sup> As early as 1962, these investigators were thinking about immunological control of leukemia.<sup>[30]</sup>

With this thought, they were far ahead of the progress in the subject across the world. We had to wait another four decades

to see the development of various monoclonal antibodies and CAR-T-cell concept to control resistant leukemia as well as certain lymphomas using specific immunological means.

She did build good hematology centers in NRS Medical College, Kolkata, and in the Medical College, Calcutta (now Kolkata Medical College). It is her illustrious students who are now carrying the subject in West Bengal with her legacy. She also had brief training under GIC Ingram in the UK. Unfortunately, she did not get a professorial position as she did not have an MD degree but was a Ph.D. in the subject. This is unfortunate and shows the rigidity of medical council and state medical councils in our country though, in AIIMS and PGIMER, the great seat of medical learning in this country, such individuals became professors very easily then as there was no postgraduate qualification existing in that subject. She retired as the associate professor in hematology from Kolkata Medical College but could not see in her lifetime wish fulfilled, that is, that both the institutions in Kolkata where she worked diligently are now offering DM degree in clinical hematology. Her students have established an oration in her name in Kolkata Medical College and quite a few international and national luminaries have given their presentations in that oration.<sup>[33]</sup>

### DIPIKA MOHANTY (1941)

Like Prof. J B Chatterjea of the School of Tropical Medicine, Kolkata, trained three of his lady students in the subject who later on carried his legacy in the state, Prof. KC Das from PGIMER, Chandigarh, also trained three lady hematologists whose influence on the subject was widespread across the length and breadth of the country. Dipika Mohanty after finishing her MD in pathology from SCB Medical College, Cuttack, joined PGIMER, Chandigarh, under Prof. KC Das at the end of the 1960s.

Her Ph.D. program was tough, it combined experimental hematology, autoradiography, karyotyping, biochemistry, cell kinetics, and reproductive physiology in addition to standard hematology of nutritional anemia in experimental folate deficiency.<sup>[34]</sup> Dipika Mohanty stands as one of the finest pioneer woman hematologists of the 21<sup>st</sup> century. Her, more than 280 papers published in national and international journals covering almost every field of hematology clearly show her scholarship in the subject. A small sample of her publications has been referred to here.<sup>[34-44]</sup> Although she is known for her major work on blood coagulation and coagulation disorders, she established one of the finest centers of hematology at the National Institute of Immunohematology (NIIH) (ICMR) in Mumbai KEM Hospital campus. With a formidable team assembled at that center, she established molecular hematology, prenatal diagnosis in hemoglobinopathies and coagulation disorders laboratory at the center. She worked on blood group antigens

and tribal as well as community hematology. During her tenure in PGIMER, Chandigarh, between 1969 and 1992, she described the first case of antithrombin deficiency in the country and described changes in blood coagulation and platelet function in malaria and various other disorders. Her stint at Kuwait University saw her working in the area of experimental heat stress<sup>[39]</sup> and hereditary thrombophilia in that country. She established the postgraduate DM program in clinical hematology at KEM Hospital in Mumbai and edited the Indian Journal of Hematology and Blood Transfusion. She was also president of the Indian Society of Hematology and Blood Transfusion. After retirement, she is offering her service in Apollo Hospital, Bhubaneswar, India. She mentored many students and they have been carrying good hematology work across the globe.

### SUMITRA DASH (1942)

Sumitra Dash did her MD in pathology from PGIMER, Chandigarh, and joined there as a faculty member in Prof. KC Das' department. She excelled herself in the area of hemoglobinopathy and did an epidemiological study of hemoglobinopathies in the Punjabi population.<sup>[45,46]</sup> She described a new hemoglobin variant Hb J Chandigarh {alpha 2-beta 2(94)(FG1)Asp---Gly}.<sup>[47]</sup> She also used a relatively new technique of isoelectric focusing to detect hemoglobin, Barts.<sup>[48]</sup> She studied the effect of zinc on hemoglobin polymerization as a part of her fellowship work in the USA. This paper was published in the famous journal "Nature."<sup>[49]</sup> As a part of hematology and pathology team in PGI, she published nearly 100 papers. Some of her paper was also published, while she worked in Bahrain. A collection of her publication is appended in the reference section of this paper to allow one to understand the breadth of her work.<sup>[45-53]</sup> She retired as the head of the hematology department from PGIMER, Chandigarh, India.

### GURJEWAN GAREWAL (1946)

Gurjewan Garewal completes the list of last of the women hematologist trained by Prof. KC Das at PGIMER, Chandigarh. She followed Dr. Sumitra Dash to head the chair of hematology at that august institute. She specialized herself in the area of malignant hematology though by no means that were her only area of work. She went on for a commonwealth fellowship and came back with a wealth of knowledge on molecular detection of hemoglobinopathies and stem cell culture and differentiation techniques. These techniques she established in her institute and trained many students in India. She presented the first series of 21 cases of myelodysplastic syndrome in this country at the annual conference of the Indian Society of Hematology and Blood Transfusion in Kolkata (Calcutta then) in 1981. Surprisingly, this case series never saw the light of publication.

Gurjewan modernized the hematology department of Prof. KC Das with touches of molecular biology and flow cytometry. She published her work in some of the best hematology journals of her period and taught hematology to her students. She meticulously attended the pediatric hematology clinic with Dr. RK Marwaha, the pediatric hematologist at the center. A flavor of her hematology work can be found in the references below,<sup>[54-59]</sup> chosen from her 80 + publications. She took premature retirement from the service to dedicate herself to other areas of public service.

### **MANORAMA BHARGAVA (1939)**

Manorama Bhargava is another important lady pioneer of hematology specialty in India. She worked in Lady Hardinge Medical College, AIIMS, New Delhi, and in Sir Ganga Ram Hospital, New Delhi. In all these centers, she trained innumerable students in the country. Her basic training was in pathology. After finishing MD pathology at Lady Hardinge Hospital in 1969, she joined the faculty position. Her publication on burn injury and red cell destruction in experimental animals was very well conducted but little talked of in the country. Like Dipika Mohanty and Sushila Swarup Mitra, she published in every area of hematology but is better known for her work on leukemia immunophenotype, molecular, and cytogenetic studies in acute leukemia. She availed several fellowships, won a few national awards and adorned the official positions in the Indian Society of Hematology and Blood Transfusion. During her stay at AIIMS, she started a DM program in hemato-oncology as well as a DM program in laboratory hematology. She published more than 110 articles in various national and international journals and a sample of a few of them referred to here clearly establishes her as one of the leading figures in the subject.<sup>[60-64]</sup> After retirement from AIIMS, New Delhi, she established a modern hematology laboratory at Sir Ganga Ram Hospital, New Delhi.

### **VINOD KOCHUPILLAI (NEE KANSAL, 1945)**

Vinod Kochupillai was trained in hematology in the USA and UK. She joined the All India Institute of Medical Sciences, New Delhi, as its faculty. Her interest was initially focused on the management of hematological malignancies.<sup>[65]</sup> Her interest shifted to the use of fetal liver cells as the source of hemopoietic stem cells for the management of various malignant and non-malignant hematological disorders. She also studied dynamics of engraftment, effect of HLA disparity, cryopreservation, expansion of fetal liver based, and other stem cell therapies. She also studied some of the biologies of fetal liver cell transplantation in the Rhesus monkey model. In 1986, she conducted an international conference on "Fetal Liver transplantation its application and future directions." The conference was attended by many experts in stem cell

transplantation from both sides of the Atlantic and India. The proceedings of this conference were published in an issue of the International Journal "Thymus" in 1987. Later on, with her team, she studied autologous stem cell transplantation in various disorders and also various complications associated with it.<sup>[65-68]</sup>

She had to take over responsibility as the head of the cancer center of Rotary Cancer Hospital situated within the AIIMS campus in New Delhi; hence, quite a few studies on different malignancies were published bearing her name. She studied other hematological conditions and was associated with immunology unit for sometimes at AIIMS, New Delhi, publications in that area were also seen. In later part of her research career, she got increasingly interested in Yogic processes<sup>[69]</sup> and Ayurvedic medicines to assist better management of cancer and other diseases. During her tenure, a DM course in medical oncology was developed at her center and a large number of medical oncologists in India were trained by her at her center. She published more than 120 articles in national and international journals of repute and received several national awards.

### **JAYA KASTURI (1941)**

Jaya Kasturi had a short stay in India as junior faculty in AIIMS, New Delhi. She excelled herself in the field of coagulation and was mentored by the head of the department of that time Dr. Anil K. Saraya. She developed a technique of PF3 assay and studied platelet function defects and platelet function in several pathological conditions.<sup>[70-73]</sup> She also was associated with a few other hematological papers from the institute. Later on, she migrated to Libya and then settled in the USA where she was practicing as a hematologist. She published around 15 papers during her short stint in the in India.

### **NISHI MADAN (1942)**

Nishi Madan excelled in the areas of hematology that deals with nutritional anemia, iron deficiency, and hemoglobinopathies. She did her MD pathology from PGIMER, Chandigarh, and was influenced by KC Das. She had a small stint at AIIMS, New Delhi, and joined the University College of Medical Sciences, New Delhi. Along with SK Sood, she developed a very good hematology department in the department of pathology. In addition to hemoglobinopathy and iron deficiency, she did substantial work on G6PD deficiency, interaction of iron deficiency, and hemoglobinopathy. She had exposure to both the UK and USA hematology through fellowships. She held an official presidential position in the Indian Society of Hematology and Blood Transfusion and inspired many students to take up the subject. She chaired the scientific advisory committee

meetings of NIIH, Mumbai, for many years and encouraged scientists there to take up challenges in community hematology, train personnel from various parts of India in those techniques in hematology which is asked for but not easily available in the country. Her scholarship in scientific writing is spread over more than 50 articles, a flavor of the subjects on which she wrote, which has been referenced below.<sup>[74-77]</sup>

### ZINET CURRIMBHOY (1925–2013)

Zinet Currimbhoy came to India after a very enriching training and experience at several centers in the USA and Canada (Toronto, Michael Reese, St. Louis, Washington, Cornell, and New York Blood Center). She was an American citizen of Indian origin but worked tirelessly in Wadia Children Hospital, Mumbai, for more than 40 years. She developed pediatric hematology oncology and immunology department through her untiring effort. She trained a series of pediatric hematologist oncologists in India and donated her life's earning of 25 lakh rupees for the development of the pediatric immunology section in Wadia Children's Hospital along with a fellowship in the same subject. She started her work on blood coagulation and platelet biology in the USA but as it happens in India, she had to see patients with every hematology problem. Later on, her interest got focused on pediatric immunodeficiency and requested the then director of NIIH (the present author) to take interest in that subject and develop a good diagnostic facility for immunodeficiency research at NIIH (under ICMR). At present, the two institutes together, that is, Wadia Children Hospital and NIIH, have become the leading center of immunodeficiency research and management in this country and also internationally. She does not have a long list of publications. However, in over 30 odd articles in various national and international journals, her scholarship in the subject was evident.<sup>[78,79]</sup>

### UMA KHANDURI (NEE NAIR: 1946)

Uma Khanduri did her MD in pathology at CMC, Vellore, followed by a Ph.D. on platelet disorders under D G Pennington in Melbourne, Australia. She is extremely well regarded as an all-round hematologist wherever she worked. After her initial stint at CMC, Vellore, she spent a large amount of her time in Oman in Arabian Gulf and subsequently coming back to India, she joined St. Stephen Hospital in New Delhi. Her main area of interest was in inherited coagulation disorder and platelet disorders. She published a series of patients with Glanzmann's thrombasthenia as well as Bernard-Soulier syndrome from South India. She was and is an extremely good morphologist, rare expertise seen nowadays. She did not publish very extensively but a sample from her 30 odd publications has been appended here.<sup>[80-84]</sup>

## DISCUSSION

Here in this review, I have sketched the activities of 13 women hematologists who were pioneers in the subject during the formative period of the speciality in the past century. On the bedrock of their effort and scholarship, many women hematologists now have come up in the present century and made their mark in both in national and international arena. In this review, I have not included those who restricted their activities in blood banking. However, out of these 13 personas reported; here, a few of them were also involved in some blood banking activities.

The earliest lady doctor who did seminal work both in experimental and nutritional hematology was Lucy Willis, her discovery of efficacy of crude liver, yeast extract, and marmite but not extremely pure liver extract toward successful treatment of pregnancy-associated macrocytic anemia and nutritional megaloblastic anemia paved the way for discovery of folic acid 10 years later. The second pioneer Betty Cowan who was also British like Lucy Willis came to India 28 years after Lucy Willis and also worked on epidemiology and gastrointestinal changes in the same disease. Hence, for almost three decades, we had a great void in the subject. We should not forget during this time 6 years of the Second World War and great upheaval in the country due to the freedom movement could have deterred even the bravest soul to tread in this fledgling speciality. We started having Indian women hematologists in the 1960s. Mary Cutbush with Herman Lehmann described sickle cell trait for the 1<sup>st</sup> time from Nilgiri tribes in South India.<sup>[85]</sup> This was a momentous discovery but Mary Cutbush never stayed in this country; hence, I have not included her in the present discussion.

There were certain peculiarities of the lady pioneer hematologists in the country. Although all the hematologists worked in all the fields of hematology, 5 out of 11 (46%) of them started their work in the field of blood coagulation. Definitely one of the most difficult areas to work on Mohanty, Bhargava, Kasuri, Khanduri, and Currimbhoy but all of them made original contribution to the subject. Very few of them devoted their work to the clinical side (Kochupillai, Currimbhoy, and Ghose). Sushila Swarup Mitra, Dipika Mohanty, and Uma Khanduri were adept at working both in clinical and laboratory hematology. Sushila Swarup Mitra, Sandhya Ghose, Dipika Mohanty, and Uma Khanduri also had PhD/D Phil with their qualification. Some of them did not do MD as a postgraduate medical degree. Two of the 11 women hematologists worked both with ICMR and leading medical institutions in India; hence, they produced a huge amount of research publications (Sushila Swarup Mita and Dipika Mohanty). As expected hematologists in the last century were largely absorbed with work on nutritional anemia, hemoglobinopathy, and coagulation disorders. Hematological

malignancies were a later addition with its growing interest in the field. There had been many writings on the difficulties faced by women scientists in general, in India, and abroad and also their triumphs against various odds. Current improvement in their number, and performance in certain sections of research have also been highlighted.<sup>[86]</sup> However, few articles are seen on women medical practitioners from different specialties, not to speak of a rare and newly upcoming specialty like hematology.<sup>[1]</sup> In this area, very few papers could be seen in the international arena also. It is heartening to see that India did produce women hematologists of great caliber who mentored many students including lady students preparing them for the subject in the coming century.

## CONCLUSION

Women pioneers in haematology were not late in arriving on the Indian scene compared to International standards. Rather they started contributing to teaching and research in haematology very early in the subject when even lady doctors had difficulty in securing a consultant level position in the western countries. This is best exemplified by the work of Dr Lucy Willis in India. Fortunately today a large number of women haematologists are working in the field of haematology in the cutting edge areas of coagulation, stem cell transplantation, haemoglobinopathy and leukaemia biology to say the least.

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## Conflicts of interest

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