Agnogenic myeloid metaplasia: role of splenectomy

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Summary
The splenomegaly associated with myelofibrosis and agnogenic myeloid metaplasia should not be considered a manifestation of the fundamental proliferative process, nor should it be considered as necessarily compensatory for reduced marrow haematopoiesis.

In deserving cases splenectomy may cause an improvement in the patient's general and haematopoietic status. Removal of the source of functional hypersplenism, causing haemolytic episodes and thrombocytopenia, results in marked amelioration in the clinical condition with reduction in the magnitude and frequency of replacement blood transfusion.

The massive size of the spleen associated with this condition may not only cause local pain and discomfort but may lead to traumatic or spontaneous rupture.

Consideration of two cases studied by the authors indicates that marked clinical improvement may be associated with splenectomy in selected cases of agnogenic myeloid metaplasia.

Introduction
The term agnogenic myeloid metaplasia of the spleen was first used by Jackson, Barker & Lemon (1940), in describing a condition in which the spleen becomes the site of extramedullary haematopoiesis. This extramedullary haematopoiesis, which involves the whole reticulo-endothelial system, is maximal in the spleen and results clinically in varying degrees of hepatomegaly and gross splenomegaly, and had been considered compensatory to failure of the bone marrow to carry out its haematopoietic function.

Bone marrow changes in these patients will vary from hyperplastic to hypoplastic with varying degrees of fibrosis. Myelofibrosis reflects the final end-stage of this disease with complete replacement of bone marrow spaces by fibrous tissue. The peripheral blood may demonstrate anaemia with features of haemolysis or may present with the effects of hypersplenism, or it may show a pseudo-leukaemic picture which does not, however, demonstrate the neoplastic invasive properties of true leukaemia. The range of disorders in this broad syndrome may be represented by polycythaemia vera or erythraemic leukaemia, referred to as di Guglielmo's syndrome, or may finally become manifest with a true leukaemia.

Synonyms for this condition include such items as leucoerythroblastic anaemia, non-leukaemic myelosis and myeloproliferative syndrome.

Hickling (1937) reviewed twenty-seven cases of this condition in the literature in 1937 and found that most of these patients had undergone splenectomy on the erroneous diagnosis of splenic anaemia. The myeloid hyperplasia of the spleen was discovered after splenectomy, and he noted that in this series eighteen post-operative deaths had occurred, reinforcing the belief that the spleen provided an essential haematopoietic compensatory function and that its removal would result in death. In emphasizing the high mortality rate for splenectomy in this condition, he remarked that twelve patients died within 4 days and fifteen were dead within 4 weeks.

Wyatt & Sommers (1950), in a study of chronic marrow failure associated with myelosclerosis and extramedullary haematopoiesis, indicated that fibrosis of the marrow could be induced by many agencies. Thus, toxic agents, hepatic dysfunction or haemolysis, as well as cardiovascular or endocrine disorders might stimulate the pluri-potential cells of the reticulo-endothelial system to revert to embryonic erythroblastic activity. It is, therefore, important to appreciate that myelofibrosis does not always precede splenomegaly or anaemia and that myeloid splenic metaplasia may occur without myelofibrosis. In considering the relationship of myeloid metaplasia and myelofibrosis, Vaughan & Harrison (1939) were probably close to the truth when they...
postulated that myelofibrosis and extramedullary haematopoiesis may provide a concurrent response to a common, as yet undefined, stimulus. It, therefore, becomes necessary to differentiate a primary type of myelofibrosis from a secondary group of bone marrow hypoplasia and fibrosis due to exogenous chemical toxins or malignant marrow infiltration or tuberculosis of bone.

Dameshek (1951) in speculating on the relationships of myelofibrosis, agnogenic myeloid metaplasia, polycythaemia rubra vera, leucoerythroblastic anaemia, erythroleukaemia and chronic myeloid leukaemia in the myeloproliferative syndromes, suggested that all these conditions represent variations in the broad spectrum of the myeloproliferative syndrome. Wasserman (1954), in his studies, tended to confirm this view and noted that 10–30% of patients with polycythaemia rubra vera would develop anaemia with myelofibrosis and myelometaplasia of the spleen and that the greater the splenic enlargement, the more likely the development of marrow and peripheral blood changes. Thus, some patients with polycythaemia rubra vera who develop agnogenic myeloid metaplasia and myelofibrosis may finally terminate with chronic myeloid leukaemia. Hutt, Pinninger & Wetherby-Mein (1953), in further demonstrating the close relationship between polycythaemia rubra vera, leukaemia and other blood disorders, emphasized that the splenic enlargement should be considered a manifestation of the fundamental proliferative process and should not be considered as compensatory for reduced marrow haematopoiesis.

This view served as a spur to Green, Conley and their associates (1953) who studied five patients with agnogenic myeloid metaplasia subjected to splenectomy. In contradistinction to the views of Hickling, they noted that splenectomy resulted in no deleterious effects in this series of five patients and that one patient was remarkably improved. In their series, four of the patients were demonstrated to have myelofibrosis and all had a leucoerythroblastic peripheral blood pattern and myeloid metaplasia in the spleen or liver. In each of these cases, splenomegaly was the prominent feature leading to splenectomy. Similarly, Bukh & With (1945) studied a patient with chronic non-leukaemic myeloid splenomegaly associated with osteosclerosis in whom splenectomy was performed and collected fifty-four similar cases in whom splenectomy has not been shown to have a harmful effect, emphasizing that the occasional patient will have definite clinical and haematological improvement after operation.

Szur & Smith (1961) rationalized the indications for splenectomy in myelosclerosis and suggested that it was indicated if a markedly decreased red blood cell survival time was demonstrated with clear-cut evidence of splenic red blood cell destruction. Significant extramedullary haematopoiesis should not be present in the spleen or, if present, evidence of significant haematopoiesis in the liver or bone marrow should be manifest. Linman & Bethell (1957), in considering the natural history and present-day management of agnogenic myeloid metaplasia, consider this disorder to be a progressively fatal disease in which splenectomy should be used as an adjunct in controlling the haemolytic component of the disease without affecting the patient’s life-span.

Two patients with agnogenic myeloid metaplasia and gross splenomegaly have been studied by the author and merit description in consideration of the benefits of splenectomy in this condition.

Case 1
This 62-year-old white female presented with a 5-month history of vague pains in the legs and non-descriptive weakness. A large spleen was noted by the physician she consulted. Apart from having undergone a thyroidectomy 26 years earlier and a cholecystectomy soon after this, followed by a vaginal hysterectomy, she had been in good health in the ensuing years with no history of allergy or hypersensitivity to past medications. Her blood pressure was noted to be 140/100 mmHg and the only other abnormality found was a mass extending for four fingers below the left costal margin to the umbilicus, moving with respiration, which was undoubtedly the spleen.

Investigations were all normal except that for a mild increase in the cephalin flocculation and thymol turbidity tests.

Peripheral blood examination: Hb 15·7 g/100 ml, PCV 52 and WBC 10,800 mm³ with 76% segmental forms, 8% stabs, 10% lymphocytes, 3% mononuclear, 2% eosinophils and 1% metamyelocytes. Platelets were noted to be adequate. A repeat blood smear, performed on the 29 May 1965 showed: Hb of 17·2 g/100 ml, PCV 52, WBC 10,700 with 2% bands, 75% neutrophils, 22% lymphocytes and 1% monocytes. There was some poikilocytosis and anisocytosis of the red cell series which seemed out of keeping with the haemoglobin level. Beyond this, apart from some bizarre and abnormal sized platelet forms, the platelets were normal in number. Spherocytes were absent and there was no evidence of any haemolysis.

Bone marrow study carried out at this time showed that the marrow cavity had been entered and demonstrated granulocytic and erythroid precursors along with masses of platelets. The erythroid series were noted to be normoblastic, but there were too few cellular elements to make any
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definitive statement on the basis of this bone marrow. Because of the large size of the spleen and the
possibility that splenectomy might be helpful in
what was thought to be early myelofibrosis with
agnogenic myeloid metaplasia, splenectomy was
carried out on 1 June 1965.

Operation

Splenectomy was performed through a long left
upper paramedian incision and, on opening the
peritoneal cavity, there was no obvious abnormality
in the liver or any other evidence of disease apart
from a massively enlarged spleen. The gastrocolic
omentum was severally divided, thereby gaining
entrance to the lesser sac, and the splenic artery was
dissected out and ligated in continuity. The spleen
was then mobilized and removed. Gross examina-
tion demonstrated a grossly lobulated spleen weigh-
ing approximately 850 g. It measured $27 \times 14 \times 9$ cm
and, on cut section, revealed a dark red meaty pulp.

Microscopic examination of the spleen demon-
strated accentuation of the splenic sinusoids and
residua of the widely separated germinal centres
about splenic arterioles. The splenomegaly was due
to a marked increase in the red pulp with evidence
of fibrosis and thickening of the splenic cords.
Abnormal cells which were muti-nucleated and
extremely large were noted and thought to be
megakaryocytes. Evidence of erythropoietic activity
was also represented by normoblastic activity.

Biopsy of the liver was also performed and
histological study demonstrated a normal architec-
ture with no discernible abnormality apart from
an increase in the amount of pigment within the
Kupffer cells.

Progress

Post-splenectomy study of the peripheral blood
smear demonstrated remarkable, sudden and striking
changes in the peripheral blood. The white cell count
rose to 40,800 with 12% bands, 75% neutrophils,
7% lymphocytes and 1% myelocytes with dis-
cernible nucleated red cells. Platelets increased to
758,000, Hb to 14.3 g/100 ml, PCV 45; there was
moderate poikilocytosis and anisocytosis. Frag-
mented megakaryocytes were noted in the peri-
pheral blood. This marked thrombocytosis was
more than could be part of a post-splenectomy
thrombocytosis. Repeat peripheral blood examina-
tion 4 days later showed that the platelet count had
become massive and was of the order of 2,452,000,
the Hb 12.1 g/100 ml, PCV 40 and WBC 433,200 with
1% bands, 71% neutrophils, 12% lymphocytes,
8% eosinophils, 1% basophils, 2% metamyelocytes
and 1% myelocytes. There were four nucleated red
cells per 100 nucleated cells.

A bone marrow study carried out on the 7th
post-operative day resulted in the first tap being a
dry tap. The sternum was subsequently entered
successfully and an aspirate was obtained. A study
of the marrow revealed whole fields and sheets of
platelets and yet a strange lack of megakaryocytes.
The granulocytic series appeared normal. There was
a normoblastic erythropoiesis and the lymphocytic
elements were normal. A study of the leucocyte
alkaline phosphatase carried out on the bone
marrow and the peripheral blood demonstrated a
marked increase over normal controls indicating
that the high white count was consistent with
leukaemoid reaction rather than leukaemia.

Conclusion

There seems little doubt that a haematological
diagnosis of the myeloproliferative syndrome may
be made associated with agnogenic myeloid meta-
plasia of the spleen. In view of the marked post-
operative thrombocytosis and elevated white cell
count, busulphan was administered, 2 mg three
times a day with gradual reduction of the leucocyte
counts to 10,000 and the platelets to under 300,000.
The dosage was gradually reduced and the drug
ultimately stopped. Repeat peripheral blood counts
over the ensuing 2 years have demonstrated a normal
peripheral blood picture.

Case 2

This patient was a 62-year-old white male who
presented for evaluation of splenomegaly. The
patient had no complaints or associated symptoms.
He had been followed in the medical clinics for
the previous 3 years with a history of ready bruising
over the chest.

On examination, at that time, he had been noted
to have a markedly enlarged spleen and bilateral
inguinal adenopathy. PCV 43, Hb 15 g/100 ml,
WBC 4150 with a normal differential. The platelet
count was not noted at that time. Formal bone
marrow biopsy in the right iliac crest and a right
inguinal lymph node biopsy were performed and
the pathological report was that of myelofibrosis
and chronic lymphadenitis.

Over the ensuing years, the patient had been noted
to become progressively anaemic and at this exami-
nation he had a markedly enlarged spleen, occupying
the left half of the abdomen, extending down to the
left iliac crest. No lymphadenopathy was noted.
All other systems were normal.

Investigations showed: PCV 35, RBC $3.8 \times 10^6$
with a marked increase in poikilocytes and marked
anisocytosis. Several nucleated red blood cells were
noted; WBC 8700 with 49% neutrophils, 7% myelo-
cytes, 27% bands, 12% lymphocytes, 4% basophils
and 1% eosinophils. The platelet count was 66,000 and bleeding and clotting times were normal. Total proteins were 7.4 g/100 ml, albumin 4.7, alkaline phosphatase 1.68 Bodansky units, fasting blood sugar 72 mg/100 ml and BUN 7.6 mg/100 ml.

Bone marrow study carried out on 29 January 1968 revealed the presence of myelofibrosis. Haematopoietic activity was present, but it was noted that despite many megakaryocytes there was very little budding of platelets.

**Operation**

In view of the very large spleen and the fact that there was adequately functioning bone marrow with evidence of superposed hypersplenism as manifested by the low platelet count, it was decided to perform a splenectomy and, at this time, a large spleen, weighing 2750 g, with a splenic artery aneurysm, which had manifested with calcification on a plain film of the abdomen, was found (Fig. 1). A splenectomy was accordingly carried out after ligating the splenic artery, removing the spleen and the aneurysm (Fig. 2). No splenunculi were noted and a liver biopsy was performed. The patient made an uneventful recovery from his operation and on the 10th post-operative day haematological examination showed: PCV 37 with fifty-nine nucleated red blood cells, WBC 17,850/mm³ with 70% neutrophils, 3% myelocytes, 15% bands, 7% lymphocytes, 4% basophils and 1% eosinophils, platelet count 228,000/mm³. Over the ensuing 3 months, this patient's haematocrit and red blood cell picture has remained constant. A marked increase in the plate-
let count to over 300,000 has been maintained (Fig. 3) and a repeat examination of marrow has demonstrated a near normal appearance without any gross evidence of myelofibrosis.

Comment

The unsatisfactory results reported by Hickling let to a general disinclination to recommend splenectomy for agnogenic myeloid metaplasia. With the elaboration of the concept that splenic enlargement is not necessarily a manifestation of the fundamental proliferative process and is not compensatory for the reduced marrow haematopoiesis, a better climate has developed for consideration of this operation (Fishman & Ballinger, 1965). In considering the criteria for splenectomy in patients with myelofibrosis and agnogenic myeloid metaplasia, specific indications would include:

1. Clear-cut evidence of splenic red blood cell destruction associated with decreased red blood cell survival time.
2. Absence of significant extramedullary haematopoiesis in the spleen or evidence of significant haematopoiesis in the liver or bone marrow.

If frequent blood transfusions are required to keep up with the rate of splenic red blood cell destruction, it would be fair to recommend splenectomy without undue consideration of the presence of haematopoietic activity in the bone marrow or elsewhere in the reticulo-endothelial system. If the haemolysis is a manifestation of hypersplenism, splenectomy may provide great benefit from the removal of this large reticulo-endothelial reservoir of blood destruction.

The superposition of hypersplenism upon the defective bone marrow haematopoiesis fortifies the clinician in recommending splenectomy and the experience in the two cases strongly suggests that removal of the spleen may reverse the polarity that has developed between the bone marrow and the spleen with possible resumption of bone marrow activity and improvement in the myeloproliferative state. In addition, the removal of a very large spleen with its susceptibility to traumatic rupture, provides a further reason for considering splenectomy.

References


