

## **Hematology-Oncology Bibliography**

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# Hematology/Oncology Bibliography

## Aspiration

- Winfield DA, Polaczar, SV. Bone marrow histology 3: Value of bone marrow core biopsy in acute leukemia, myelodysplastic syndromes, and chronic myeloid leukemia. Journal of Clinical Pathology 1992;45:855-9** 42  
This article examines the role bone marrow aspirate and core biopsy play in diagnosis and regular monitoring of acute myeloblastic leukemia (AML), megakaryoblastic leukaemia and acute myelofibrosis, acute lymphoblastic leukemia (ALL), myelodysplastic syndromes (MDS), and chronic myeloid leukemia (CML). The authors conclude that a core biopsy specimen complements the peripheral blood and marrow aspirate findings in providing additional information for the diagnosis and assessment of prognosis.
- Garrett TJ, Gee TS, Lieberman PH, McKenzie S, Clarkson BD. The role of bone marrow aspiration and biopsy in detecting marrow involvement by nonhematologic malignancies. Cancer 1976;38(6):2401-3** 51  
This abstract describes the review of records at memorial Sloan-Kettering Cancer Center evaluating biopsy and aspirate testing. Supports both aspiration and biopsy are indicated for full evaluation of bone marrow in cancer patients.  
*Abstract*
- Musolino A, Guazzi A, Nizzoli R, Panebianco M, Mancini C, Ardizzoni A. Accuracy and relative value of bone marrow aspiration in the detection of lymphoid infiltration in non-Hodgkin lymphoma. Tumori 2010;96:24-7.** 52  
This article evaluates the correlation between bone marrow aspirate and biopsy results in 51 patients with NHL that received both procedures simultaneously. They found that the agreement level was 80% for this patient population, with discrepancies in 20% of cases evaluated.
- Pileri S, Poggi S, Baglioni P, Montanari M, Sabattini E, Galienu P, et al. Histology and immunohistology of bone marrow biopsy in multiple myeloma. Eur J Haematol Suppl 1989;51:52-9** 53  
Fixed biopsy samples from 125 multiple myeloma patients were reviewed according to morphological and immunohistological criteria. Comparison of the findings of biopsies and aspirates, the aspirate sample lead to an underestimation of the tumor burden in 30% of cases.  
*Abstract*
- Graf BL, Korte W, Schmid L, Schmid U, Cogliatti SB. Impact of aspirate smears and trephine biopsies in routine bone marrow diagnostics: a comparative study of 141 cases. Swiss Med Wkly 2005;135:151-9.** 56  
Compares the diagnostic impact of bone marrow cytology in combination with flow cytometry analysis of aspirate smears and bone marrow histology together with immunohistochemical examination of trephine biopsies. Diagnoses between aspirate and biopsy were concordant in 80.5% cases.
- Bearden JD, Ratkin GA, Coltman CA. Comparison of the diagnostic value of bone marrow biopsy and bone marrow aspiration in neoplastic disease. J Clin Pathol 1974;27:738-40** 59  
Evaluation of 205 simultaneously collected bone marrow biopsy and aspirate specimens from patients with lymphoma, leukemia, and a variety of solid tumors. Specimens were evaluated for adequacy, number of positive biopsies, and disparity between biopsy and aspirate.
- Swords A, Anguita J, Higgins RA et al. A New Rotary Powered Device for Bone Marrow Aspiration and Biopsy Yields Superior Specimens with Less Pain: Results of a Randomized Clinical Study. Blood 2010;116(21):650-1** 3  
This abstract describes a 50-patient study that compared the powered device to the traditional manual technique by relatively assessing pain scores, procedure times, biopsy capture rates, quality of material retrieved, safety and operator satisfaction. Results suggest that the use of a powered bone marrow biopsy device significantly reduces needle insertion pain. Moreover, the superior size and overall quality of core specimens retrieved by the powered device provides more material for pathologic evaluation, thereby increasing diagnostic yield and reducing the need for repeat procedures.
- Barekman CL, Fair KP, Cotelingam JD. Comparative utility of diagnostic bone-marrow components: a 10 year study. Am J Hematol 1997;56:37-41** 32  
This article describes a 10 year study of 4,902 patients receiving bone marrow procedures to assess the value of specific components. Investigators concluded that bilateral aspirates with biopsies are needed for diagnosis in staging for neoplasms, and that a unilateral aspirate with biopsy is sufficient to assess patients with cytopenia and leukemia.

# Hematology/Oncology Bibliography

## Aspiration

**Islam A, Henderson ES. Value of long-core biopsy in the detection of discrete bone marrow lesions. Histopathology 1988;12:641-8**

34

This article describes a study involving 256 bone marrow biopsy procedures, in which biopsy specimens were compared with peripheral blood smears and bone marrow aspirates. Researchers concluded that when blood and aspirate samples fail to indicate the diagnosis, a long-core biopsy may provide positive results.

# Hematology/Oncology Bibliography

## Case Study

- Morra E, Lazzarino M, Castello A, Dinverardi D, Coci A, Pagnucco G. Bone marrow and blood involvement by non-Hodgkin's lymphoma: A study of clinicopathologic correlations and prognostic significance in relationship to the Working Formulation. Eur J Haematol 1989;42:445-53** 67  
The objective of this study was to determine the clinicopathologic correlations and impact on survival of bone marrow and peripheral blood involvement in a series of 172 cases of NHL. Results showed that the overall incidence of blood involvement by lymphoma was 28.5%; blood involvement correlated with splenomegaly, bulky disease, advance clinical stage, and extent of bone marrow infiltration.
- Chamisa I. Fatal vascular retroperitoneal injury following bone marrow biopsy. SAMJ 2007;97(4):246** 10  
This article describes a case study in which a patient died as a result of abdominal compartment syndrome, secondary to extravasation following a bone marrow biopsy procedure.
- Lowenthal RM, Taylor BV, Jones R, Beasley A. Severe persistent sciatic pain and weakness due to a gluteal artery pseudoaneurysm as a complication of bone marrow biopsy. Journal of Clinical Neuroscience 2006;13:384-5** 14  
Case study is presented describing a case of severe and debilitating sciatic nerve palsy secondary to gluteal artery pseudoaneurysm following a bone marrow biopsy procedure.
- Önal IK, Sümer H, Tufan A, Shorbagi A. Bone marrow embolism after bone marrow aspiration and biopsy. American Journal of Hematology 2005;78:158-65** 20  
Letter to the editor described a case of bone marrow embolism following bone marrow procedures.
- Farrow A, Morrison R, Pickersgill T, et al. Transient femoral neuropathy after harvest of bone from the iliac crest. British Journal of Oral and Maxillofacial Surgery 2004;42:572-4** 21  
This is a report of a case in which a 31-year-old woman had bone harvested from the left anterior iliac crest, and sustained a subsequent temporary femoral mononeuropathy. She later recovered completely.
- Arellano-Rodrigo E, Real MI, Muntanola, Burrel M, Rozman M, Fraire GV, Cervantes F. Successful treatment by selective arterial embolization of severe retroperitoneal hemorrhage secondary to bone marrow biopsy in post-polycythemic myelofibrosis. Ann Hematol 2004;83:67-70** 22  
This case study describes endovascular approach in providing fast and minimally invasive treatment of retroperitoneal hemorrhage following bone marrow biopsy.
- Marti J, Anton E, Valenti C. Complications of bone marrow biopsy. British Journal of Haematology 2004;124:557** 24  
This is a letter to editor which reviews typical complications associated with bone marrow procedures and presented the case of a fatality associated with a sternal bone marrow procedure.
- Salem P, Wolverson MK, Reimers HJ, Kudva GC. Complications of bone marrow biopsy. British Journal of Haematology 2003;121:821** 27  
The author of this letter to editor presented two cases of hemorrhaging associated with bone marrow procedures.

# Hematology/Oncology Bibliography

## Clinical Study

- Berenson JR, Yellin O, Blumenstein B, Bojanower D, Croopnick J, Abouafia D, et al. Using a powered bone marrow biopsy system results in shorter procedures, causes less residual pain to adult patients, and yields larger specimens. *Diagnostic Pathology* 2011;6:23** 45
- This article outlines the 102 patient, multi-center, randomized, controlled trial comparing the powered OnControl system to the standard manual technique in community-based cancer clinics. Thirteen device operators from 10 sites participated. Procedure time was significantly less for the powered device ( $102.1 \pm 86.4$  seconds) compared to the manual device ( $203.1 \pm 149.5$  seconds;  $p < 0.001$ ). One day following the procedure more patients were pain-free from the powered group (67%) than the manual group (33%); sample volume was larger for the powered group ( $36.8 \text{ mm}^3 \pm 21.2$ ) than the manual group ( $20.4 \text{ mm}^3 \pm 9.0$ ;  $p = 0.039$ ). Conduct of this trial was sponsored by Vidacare Corporation.
- Faugere MC, Malluche HH. Comparison of different bone-biopsy techniques for qualitative and quantitative diagnosis of metabolic bone diseases. *J Bone Joint Surg Am* 1983;65:1314-8** 46
- This study compared bone biopsy samples taken using a 3mm diameter Jamshidi needle and 5mm diameter electric drill for qualitative and quantitative study of bone histology. Statistical evaluation of the differences and correlations between histomorphometric parameters was performed; results showed that 3mm diameter samples were sufficient for qualitative diagnosis but were not optimum for the quantitative evaluation of cellular parameters of resorption and formation.
- Park SH, Bang SM, Nam E, Cho EK, Shin DB, Lee JH, et al. A randomized double-blind placebo controlled study of low-dose intravenous lorazepam to reduce procedural pain during bone marrow aspiration and biopsy. *Pain Medicine* 2008;9(2):249-52** 47
- This study evaluated the efficacy of IV lorazepam, 1mg, as premedication for bone marrow aspiration and biopsy procedures. 138 patients were enrolled, all received local 1% lidocaine and either lorazepam or placebo just before the procedure. Outcome measures included a questionnaire to determine patient perception of the procedure and pain assessments at baseline, just following the procedure, and the next day using a 10cm VAS. Results: IV lorazepam, 1mg, provides no reduction in pain associated with bone marrow aspiration biopsy procedures; more patients receiving the lorazepam reported they were more likely to agree to a second bone marrow procedure.
- Beall DP. Powered bone access system facilitates faster vertebroplasty procedures. *Skeletal Radiology* 2011;40:514-5** 55
- This abstract describes a clinical evaluation of the Vidacare Bone Access System, used to access the vertebral body for delivery of bone cement during vertebroplasty procedures. Clinicians used the device to perform 43 vertebroplasty procedures on 40 patients. All procedures were successful and there were no complications. Conduct of this trial was sponsored by Vidacare Corporation.
- Abstract*
- Ruegg TA, Curran CR, Lamb T. Use of buffered lidocaine in bone marrow biopsies: A RCT: Theoretical Framework. *Oncology Nurse Forum* 2009;36(1):52-60** 62
- A double-blind, randomized crossover study in which 48 patients received bilateral bone marrow biopsy procedures, one side with buffered lidocaine and one side with unbuffered lidocaine. Results showed that using 100 mm VAS (visual analog scale) pain scale, patients reported significantly lower pain scores on the buffered lidocaine side than the unbuffered lidocaine side.
- Berenson JR, Yellin O, Blumenstein B, Philbeck T. Rotary-powered bone marrow access results in shorter procedure time, larger core specimens and less residual pain for patients. *J Vasc and Interv Radiol* 2011;22(3):S15** 64
- This abstract describes the 102 patient, multi-center, trial comparing the powered OnControl system to the standard manual technique. Results showed procedure time was significantly less, more patients were pain free one day following the procedure, and sample volume was larger for the powered group. This trial was sponsored by Vidacare Corporation.
- Abstract (Oral Presentation at 2011 SIR)*
- Berenson J, Yellin O, Bojanower D et al. A Multicenter Randomized Clinical Trial Comparing a Powered Bone Marrow Biopsy System and Manual Bone Marrow Biopsy Procedures. *Blood* 2010;116(21):1571** 4
- This abstract describes a 102-patient multicenter randomized clinical trial that was designed to determine if a new powered bone marrow sampling device has advantages over traditional manually-inserted needles in terms of decreased pain, decreased procedure time, higher biopsy core capture rate, ease of use, improved sample yield, and higher operator satisfaction scores. Results suggest use of the powered bone marrow biopsy device markedly shortens the procedure time and reduces intermediate-term pain—important considerations for the quality of life for patients undergoing this procedure.
- Abstract*

# Hematology/Oncology Bibliography

## Clinical Study

- Swords RT, Kelly KR, Cohen SC et al. Rotary powered device for bone marrow aspiration and biopsy yields excellent specimens quickly and efficiently. J Clin Pathol 2010;63:562-5** 6
- This article summarizes a preclinical study designed to determine cellular artifact or thermal damage resulting from powered bone marrow sampling and a clinical evaluation of the powered bone marrow sampling device. No cellular artifact or thermal damage was found and the device was found to be safe and easy to use, with significantly shorter procedure time than when using a manual technique.
- Swords RT, Kelly KR, Mahalingam D, Cohen SC, Miller LJ, Philbeck TE, PhD, Hacker SO, Spadaccini CJ, Brenner A, Giles FL. Use of a new rotary powered device for bone marrow aspiration and biopsy yields excellent specimens quickly and efficiently. Abstract #4544r appears in Blood 2009, 114(22)** 7
- This abstract summarizes a preclinical study designed to determine cellular artifact or thermal damage resulting from powered bone marrow sampling and a clinical evaluation of the powered bone marrow sampling device. No cellular artifact or thermal damage was found and the device was found to be safe and easy to use, with significantly shorter procedure time than when using a manual technique.
- Cohen SC, Soroka JM. Evaluation of a powered intraosseous device for bone marrow sampling. Biology of Blood and Marrow Transplantation 2008;14(2) s2:61. Abstract 162** 8
- This abstract describes an observational study designed to evaluate the ability of a new powered bone marrow aspiration device to obtain bone marrow samples. Mean needle insertion time was significantly lower than previously reported. Findings suggested the device is safe and effective.
- Buckley O, Benfayed W, Geoghegan T, et al. CT-guided bone biopsy: Initial experience with a commercially available hand held Black and Decker™ drill. European Journal of Radiology 2007;61:176-80** 9
- This article describes a 68 patient study in which patients underwent bone biopsy using a Black and Decker drill to access the iliac crest. Investigators successfully obtained diagnostic material in 80% of the cases with no major complications.
- Cohen SC, Soroka JM. Evaluation of a powered intraosseous device for bone marrow sampling. Blood 2007;110. Abstract 5150** 11
- This abstract describes an observational study designed to evaluate the ability of a new powered bone marrow aspiration device to obtain bone marrow samples. Mean needle insertion time was significantly lower than previously reported. Findings suggested the device is safe and effective.
- Islam A. Bone marrow aspiration before bone marrow core biopsy using the same bone marrow biopsy needle: a good or bad practice?. J Clin Pathol 2007;60:212-5** 12
- This article describes a clinical study of bone marrow aspiration and core biopsy procedures in which single-single needle/single-site technique was compared to a double-needle technique. Investigators found the double-needle technique to be superior.
- Kuball J, Schuz J, Gamm H, Weber W. Bone marrow punctures and pain. Acute Pain 2004;6:9-14** 17
- This article describes a 263 patient study in which patients receiving bone marrow procedures were evaluated for pain. Substantial pain was reported by 30.4% of patients, but physicians did not realize the pain was felt in more than 50% of the cases. Duration of the procedure was identified as the sole independent predictive factor for patients' pain intensity.
- Miller L, Philbeck T, Montez D et al. Comparing Powered Bone Marrow Biopsy Procedures to Manual Bone Marrow Biopsy Procedures Using Healthy Volunteers. Blood 2010;116(21):648** 2
- This abstract describes a 24-subject/48-biopsy specimen study designed to determine if the powered bone-marrow biopsy device has advantages over traditional manual devices in terms of decreased pain, insertion time, and improved sample yield. Results suggest the superior size and overall quality of core specimens delivered by the powered device may provide more material for pathological evaluation of hematopoietic and oncological disorders. The powered device was significantly faster in obtaining a biopsy than the manual device and its capture rate in obtaining a satisfactory sample was much higher. Use of the powered device significantly decreases overall procedure pain.

# Hematology/Oncology Bibliography

## Clinical Study

- Swords A, Anguita J, Higgins RA et al. A New Rotary Powered Device for Bone Marrow Aspiration and Biopsy Yields Superior Specimens with Less Pain: Results of a Randomized Clinical Study. Blood 2010;116(21):650-1** 3
- This abstract describes a 50-patient study that compared the powered device to the traditional manual technique by relatively assessing pain scores, procedure times, biopsy capture rates, quality of material retrieved, safety and operator satisfaction. Results suggest that the use of a powered bone marrow biopsy device significantly reduces needle insertion pain. Moreover, the superior size and overall quality of core specimens retrieved by the powered device provides more material for pathologic evaluation, thereby increasing diagnostic yield and reducing the need for repeat procedures.
- Burkle CM, Harrison BA, Koenig LF, Decker PA, Warner DO, Gastineau DA. Morbidity and mortality of deep sedation in outpatient bone marrow biopsy. American Journal of Hematology 2004;77:250-6** 23
- This article describes retrospective study to establish safety of deep sedation used for adults undergoing bone marrow biopsy and aspiration. Results suggest that deep sedation for outpatient bone marrow biopsy and aspiration is as safe as using local anesthetics.
- Vanhelleputte P, Nils K, Delforge M, Evers G, Vanderschueren S. Pain during bone marrow aspiration: prevalence and prevention. Journal of Pain and Symptom Management 2003;26(3):860-6** 28
- This article describes an observational study of 132 patients undergoing bone marrow aspiration procedures. Investigators concluded that the great majority of patients experience transient pain during the procedure.
- Goldenberg AS, Tiesinga JJ. Clinical experience with a new specimen capturing bone marrow biopsy needle. Am J Hematol 2001;68:189-93** 29
- This article describes an observational study in which the SNARECOIL™ needle was used for 44 patients requiring bone marrow biopsies. Of 50 procedures, 52% of the specimens were ≥2.0cm in length.
- Barekman CL, Fair KP, Cotelingam JD. Comparative utility of diagnostic bone-marrow components: a 10 year study. Am J Hematol 1997;56:37-41** 32
- This article describes a 10 year study of 4,902 patients receiving bone marrow procedures to assess the value of specific components. Investigators concluded that bilateral aspirates with biopsies are needed for diagnosis in staging for neoplasms, and that a unilateral aspirate with biopsy is sufficient to assess patients with cytopenia and leukemia.
- Ahlstrom KH, Astrom KGO. CT-guided bone biopsy performed by means of a coaxial biopsy system with an eccentric drill. Radiology 1993;188:549-52** 33
- The authors describe a 32 patient study in which a makeshift bone biopsy system, that included a power drill, was used to obtain the bone marrow sample. Successful samples were obtained in 43% of the 37 cases.
- Islam A, Henderson ES. Value of long-core biopsy in the detection of discrete bone marrow lesions. Histopathology 1988;12:641-8** 34
- This article describes a study involving 256 bone marrow biopsy procedures, in which biopsy specimens were compared with peripheral blood smears and bone marrow aspirates. Researchers concluded that when blood and aspirate samples fail to indicate the diagnosis, a long-core biopsy may provide positive results.
- Birch CD, Fischer S, Zibell A, Jensen ME. Diagnostic bone-marrow studies extended routinely by iliac crest biopsy, using the method of Schaadt-Fischer. Acta Pathol Microbiol Immunol Scand 1982;90:229-34** 35
- This article describes a study involving 129 bone marrow biopsy procedures using Schaadt-Fischer needles and technique. Authors concluded that using the technique makes it possible to obtain adequate biopsies in 80 to 90% of all patients.
- Ellis LD, Jensen WN, Westerman MP. Needle biopsy of bone and bone marrow. An experience with 1,445 biopsies. Arch Intern Med 1964;114:213-4** 40
- The authors describe early study of 1,445 bone marrow biopsy procedures using a modification of the Silverman needle.

# Hematology/Oncology Bibliography

## Clinical Study

**Brody JI, Finch SC. Bone marrow needle biopsy. The American Journal of Medical Sciences 1959:140-5**

41

This article describes early 100-patient study of bone marrow procedures. Procedure and technique is described in great detail. With focus on patients undergoing biopsies, investigators concluded that the method is simple, safe and convenient for patients; and that the method will replace surgical procedures for obtaining bone marrow biopsies.

# Hematology/Oncology Bibliography

## Complications

- Berenson JR, Yellin O, Blumenstein B, Bojanower D, Croopnick J, Aboulafia D, et al. Using a powered bone marrow biopsy system results in shorter procedures, causes less residual pain to adult patients, and yields larger specimens. Diagnostic Pathology 2011;6:23** 45
- This article outlines the 102 patient, multi-center, randomized, controlled trial comparing the powered OnControl system to the standard manual technique in community-based cancer clinics. Thirteen device operators from 10 sites participated. Procedure time was significantly less for the powered device ( $102.1 \pm 86.4$  seconds) compared to the manual device ( $203.1 \pm 149.5$  seconds;  $p < 0.001$ ). One day following the procedure more patients were pain-free from the powered group (67%) than the manual group (33%); sample volume was larger for the powered group ( $36.8 \text{ mm}^3 \pm 21.2$ ) than the manual group ( $20.4 \text{ mm}^3 \pm 9.0$ ;  $p = 0.039$ ). Conduct of this trial was sponsored by Vidacare Corporation.
- Bain BJ. Bone marrow biopsy morbidity: review of 2003. Journal of Clinical Pathology 2005;58(4):406-8** 49
- This article summarizes the occurrence of adverse events associated with diagnostic bone marrow aspirates and trephine biopsies between January 1- December 31, 2003, as reported by members of the British Society of Haematology. Of 19,259 bone marrow procedures performed as reported by 63 hospitals, 16 adverse events were reported (0.08%) with 11 of them being hemorrhage.
- Berenson JR, Yellin O, Blumenstein B, Philbeck T. Rotary-powered bone marrow access results in shorter procedure time, larger core specimens and less residual pain for patients. J Vasc and Interv Radiol 2011;22(3):S15** 64
- This abstract describes the 102 patient, multi-center, trial comparing the powered OnControl system to the standard manual technique. Results showed procedure time was significantly less, more patients were pain free one day following the procedure, and sample volume was larger for the powered group. This trial was sponsored by Vidacare Corporation.
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- This abstract describes a 102-patient multicenter randomized clinical trial that was designed to determine if a new powered bone marrow sampling device has advantages over traditional manually-inserted needles in terms of decreased pain, decreased procedure time, higher biopsy core capture rate, ease of use, improved sample yield, and higher operator satisfaction scores. Results suggest use of the powered bone marrow biopsy device markedly shortens the procedure time and reduces intermediate-term pain—important considerations for the quality of life for patients undergoing this procedure.
- Abstract*
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- This abstract summarizes a preclinical study designed to determine cellular artifact or thermal damage resulting from powered bone marrow sampling and a clinical evaluation of the powered bone marrow sampling device. No cellular artifact or thermal damage was found and the device was found to be safe and easy to use, with significantly shorter procedure time than when using a manual technique.
- Chamisa I. Fatal vascular retroperitoneal injury following bone marrow biopsy. SAMJ 2007;97(4):246** 10
- This article describes a case study in which a patient died as a result of abdominal compartment syndrome, secondary to extravasation following a bone marrow biopsy procedure.
- Lowenthal RM, Taylor BV, Jones R, Beasley A. Severe persistent sciatic pain and weakness due to a gluteal artery pseudoaneurysm as a complication of bone marrow biopsy. Journal of Clinical Neuroscience 2006;13:384-5** 14
- Case study is presented describing a case of severe and debilitating sciatic nerve palsy secondary to gluteal artery pseudoaneurysm following a bone marrow biopsy procedure.
- Bain BJ. Bone marrow biopsy morbidity: review of 2003. J Clin Pathol 2005;58:406-8** 18
- The author reviewed adverse events associated with bone marrow procedures in the United Kingdom. She concluded that adverse events are rare during the procedures but can have considerable impact on individual patients.

# Hematology/Oncology Bibliography

## Complications

- Önal IK, Sümer H, Tufan A, Shorbagi A. Bone marrow embolism after bone marrow aspiration and biopsy. American Journal of Hematology 2005;78:158-65** 20  
Letter to the editor described a case of bone marrow embolism following bone marrow procedures.
- Farrow A, Morrison R, Pickersgill T, et al. Transient femoral neuropathy after harvest of bone from the iliac crest. British Journal of Oral and Maxillofacial Surgery 2004;42:572-4** 21  
This is a report of a case in which a 31-year-old woman had bone harvested from the left anterior iliac crest, and sustained a subsequent temporary femoral mononeuropathy. She later recovered completely.
- Arellano-Rodrigo E, Real MI, Muntanola, Burrel M, Rozman M, Fraire GV, Cervantes F. Successful treatment by selective arterial embolization of severe retroperitoneal hemorrhage secondary to bone marrow biopsy in post-polycythemic myelofibrosis. Ann Hematol 2004;83:67-70** 22  
This case study describes endovascular approach in providing fast and minimally invasive treatment of retroperitoneal hemorrhage following bone marrow biopsy.
- Marti J, Anton E, Valenti C. Complications of bone marrow biopsy. British Journal of Haematology 2004;124:557** 24  
This is a letter to editor which reviews typical complications associated with bone marrow procedures and presented the case of a fatality associated with a sternal bone marrow procedure.
- Bain BJ. Bone marrow biopsy morbidity and mortality. British Journal of Haematology 2003;121:949-51** 25  
The author describes a postal survey of British hematologists to determine adverse event rates during bone marrow procedures. Of nearly 55,000 procedures, only 26 adverse events were reported, including one death. The most frequent and serious adverse event was hemorrhage, reported in 14 cases.
- Morley NJ, Makris M. Bone marrow biopsy related haemorrhage and low molecular weight heparin. British Journal of Haematology 2003;123:561** 26  
The author of this letter to the editor opined that therapy with low molecular weight heparin should be considered an absolute contraindication to bone marrow biopsy.
- Salem P, Wolverson MK, Reimers HJ, Kudva GC. Complications of bone marrow biopsy. British Journal of Haematology 2003;121:821** 27  
The author of this letter to editor presented two cases of hemorrhaging associated with bone marrow procedures.
- van Iperen CE, Cornelissen JJ. Bone marrow aspiration, a dangerous procedure?. The Netherlands Journal of Medicine 2001;59:4-5** 31  
In this editorial, authors briefly review precautions that should be taken to perform safe bone marrow procedures.

# Hematology/Oncology Bibliography

## Devices

- Berenson JR, Yellin O, Blumenstein B, Bojanower D, Croopnick J, Aboulafia D, et al. Using a powered bone marrow biopsy system results in shorter procedures, causes less residual pain to adult patients, and yields larger specimens. *Diagnostic Pathology* 2011;6:23** 45
- This article outlines the 102 patient, multi-center, randomized, controlled trial comparing the powered OnControl system to the standard manual technique in community-based cancer clinics. Thirteen device operators from 10 sites participated. Procedure time was significantly less for the powered device ( $102.1 \pm 86.4$  seconds) compared to the manual device ( $203.1 \pm 149.5$  seconds;  $p < 0.001$ ). One day following the procedure more patients were pain-free from the powered group (67%) than the manual group (33%); sample volume was larger for the powered group ( $36.8 \text{ mm}^3 \pm 21.2$ ) than the manual group ( $20.4 \text{ mm}^3 \pm 9.0$ ;  $p = 0.039$ ). Conduct of this trial was sponsored by Vidacare Corporation.
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- Symington K, Martinez Jr F. Bone marrow procedures move into the 21st century. *Oncology NEWS International* 2010;19(9)** 54
- Brief history of bone marrow procedures and how the IO approach is revolutionizing the field. Discusses use of OnControl. Conduct of this trial was sponsored by Vidacare Corporation.
- Beall DP. Powered bone access system facilitates faster vertebroplasty procedures. *Skeletal Radiology* 2011;40:514-5** 55
- This abstract describes a clinical evaluation of the Vidacare Bone Access System, used to access the vertebral body for delivery of bone cement during vertebroplasty procedures. Clinicians used the device to perform 43 vertebroplasty procedures on 40 patients. All procedures were successful and there were no complications. Conduct of this trial was sponsored by Vidacare Corporation.
- Abstract*
- Reid MM, Roald B. Adequacy of bone marrow trephine biopsy specimens in children. *J Clin Pathol* 1996;49:226-9** 57
- Evaluation of 822 biopsy specimens for adequacy, collected from children with neuroblastoma over five years, from 25 centers. Found that 17% of biopsy specimens collected were inadequate.
- Garcia G, Miller LJ, Philbeck, T, Bolleter S, Montez, D. Tactile feedback allows accurate insertion of a powered bone access device for vertebroplasty and bone marrow sampling procedures. *J Vasc and Interv Radiol* 2011;22(3):S86** 63
- This study evaluated the ability of the clinician to successfully insert manual driven needles, hammer driven needles, and power driven needles into simulated bone material of varying depths, to the requested depth. Placement was confirmed by fluoroscopy. Results showed insertion success with manual was 48.5%, with hammer was 69.7% and, with powered was 91%; statistically significant ( $p < .05$ ). This study was sponsored by Vidacare Corporation.
- Abstract (Oral Presentation at 2011 SIR)*
- Berenson JR, Yellin O, Blumenstein B, Philbeck T. Rotary-powered bone marrow access results in shorter procedure time, larger core specimens and less residual pain for patients. *J Vasc and Interv Radiol* 2011;22(3):S15** 64
- This abstract describes the 102 patient, multi-center, trial comparing the powered OnControl system to the standard manual technique. Results showed procedure time was significantly less, more patients were pain free one day following the procedure, and sample volume was larger for the powered group. This trial was sponsored by Vidacare Corporation.
- Abstract (Oral Presentation at 2011 SIR)*

# Hematology/Oncology Bibliography

## Devices

- Berenson J, Yellin O, Bojanower D et al. A Multicenter Randomized Clinical Trial Comparing a Powered Bone Marrow Biopsy System and Manual Bone Marrow Biopsy Procedures. Blood 2010;116(21):1571** 4

This abstract describes a 102-patient multicenter randomized clinical trial that was designed to determine if a new powered bone marrow sampling device has advantages over traditional manually-inserted needles in terms of decreased pain, decreased procedure time, higher biopsy core capture rate, ease of use, improved sample yield, and higher operator satisfaction scores. Results suggest use of the powered bone marrow biopsy device markedly shortens the procedure time and reduces intermediate-term pain—important considerations for the quality of life for patients undergoing this procedure.

*Abstract*

- Miller L. Tactile Feedback Comparison of Manual, Hammer, and Rotary Powered Needle Insertion Accuracy for Bone Marrow Biopsy and Other Procedures. 52nd ASH Annual Meeting and Exposition, Orlando, FL, Orange County Convention Center, December 4-7, 2010** 5

This abstract describes a study designed to determine if clinicians were able to correctly place the needle tip into a specific target area of simulated bone more often and in less time when using rotary powered intraosseous devices than when using manually inserted devices, or hammer-assisted insertion devices, when relying primarily on tactile feedback to determine correct depth of penetration. Investigators concluded that correct placement of a bone biopsy needle into a precise target area using tactile feedback only was markedly better and faster when using a rotary powered needle than when using a manually inserted or a hammer assisted device.

- Swords RT, Kelly KR, Cohen SC et al. Rotary powered device for bone marrow aspiration and biopsy yields excellent specimens quickly and efficiently. J Clin Pathol 2010;63:562-5** 6

This article summarizes a preclinical study designed to determine cellular artifact or thermal damage resulting from powered bone marrow sampling and a clinical evaluation of the powered bone marrow sampling device. No cellular artifact or thermal damage was found and the device was found to be safe and easy to use, with significantly shorter procedure time than when using a manual technique.

- Swords RT, Kelly KR, Mahalingam D, Cohen SC, Miller LJ, Philbeck TE, PhD, Hacker SO, Spadaccini CJ, Brenner A, Giles FL. Use of a new rotary powered device for bone marrow aspiration and biopsy yields excellent specimens quickly and efficiently. Abstract #4544r appears in Blood 2009, 114(22)** 7

This abstract summarizes a preclinical study designed to determine cellular artifact or thermal damage resulting from powered bone marrow sampling and a clinical evaluation of the powered bone marrow sampling device. No cellular artifact or thermal damage was found and the device was found to be safe and easy to use, with significantly shorter procedure time than when using a manual technique.

- Cohen SC, Soroka JM. Evaluation of a powered intraosseous device for bone marrow sampling. Biology of Blood and Marrow Transplantation 2008;14(2) s2:61. Abstract 162** 8

This abstract describes an observational study designed to evaluate the ability of a new powered bone marrow aspiration device to obtain bone marrow samples. Mean needle insertion time was significantly lower than previously reported. Findings suggested the device is safe and effective.

- Buckley O, Benfayed W, Geoghegan T, et al. CT-guided bone biopsy: Initial experience with a commercially available hand held Black and Decker™ drill. European Journal of Radiology 2007;61:176-80** 9

This article describes a 68 patient study in which patients underwent bone biopsy using a Black and Decker drill to access the iliac crest. Investigators successfully obtained diagnostic material in 80% of the cases with no major complications.

- Cohen SC, Soroka JM. Evaluation of a powered intraosseous device for bone marrow sampling. Blood 2007;110. Abstract 5150** 11

This abstract describes an observational study designed to evaluate the ability of a new powered bone marrow aspiration device to obtain bone marrow samples. Mean needle insertion time was significantly lower than previously reported. Findings suggested the device is safe and effective.

- Parapia LA. Trepanning or trepanes: a history of bone marrow biopsy. British Journal of Haematology 2007;139:14-9** 13

This article provides overview of history of bone marrow biopsy procedures; includes descriptions and illustrations of antique and modern biopsy devices.

# Hematology/Oncology Bibliography

## Devices

- Roberts C, Morrison W, Leslie K, et al. Assessment of bone biopsy needles for sample size, specimen quality and ease of use. *Skeletal Radiol* 2005;34:329-35** 16
- This article describes study in which investigators assessed the differences in ease of use and quality of samples among several bone biopsy needles, including models by Coe Elson/Ackerman, RADI, Bard, MD Tech, Parallax, and Kendall. The investigators concluded that biopsy needles vary significantly in performance; and that detailed knowledge of the strengths and weaknesses of different needles is important to make an appropriate selection.
- Miller L, Philbeck T, Montez D et al. Comparing Powered Bone Marrow Biopsy Procedures to Manual Bone Marrow Biopsy Procedures Using Healthy Volunteers. *Blood* 2010;116(21):648** 2
- This abstract describes a 24-subject/48-biopsy specimen study designed to determine if the powered bone-marrow biopsy device has advantages over traditional manual devices in terms of decreased pain, insertion time, and improved sample yield. Results suggest the superior size and overall quality of core specimens delivered by the powered device may provide more material for pathological evaluation of hematopoietic and oncological disorders. The powered device was significantly faster in obtaining a biopsy than the manual device and its capture rate in obtaining a satisfactory sample was much higher. Use of the powered device significantly decreases overall procedure pain.
- Swords A, Anguita J, Higgins RA et al. A New Rotary Powered Device for Bone Marrow Aspiration and Biopsy Yields Superior Specimens with Less Pain: Results of a Randomized Clinical Study. *Blood* 2010;116(21):650-1** 3
- This abstract describes a 50-patient study that compared the powered device to the traditional manual technique by relatively assessing pain scores, procedure times, biopsy capture rates, quality of material retrieved, safety and operator satisfaction. Results suggest that the use of a powered bone marrow biopsy device significantly reduces needle insertion pain. Moreover, the superior size and overall quality of core specimens retrieved by the powered device provides more material for pathologic evaluation, thereby increasing diagnostic yield and reducing the need for repeat procedures.
- Goldenberg AS, Tiesinga JJ. Clinical experience with a new specimen capturing bone marrow biopsy needle. *Am J Hematol* 2001;68:189-93** 29
- This article describes an observational study in which the SNARECOIL™ needle was used for 44 patients requiring bone marrow biopsies. Of 50 procedures, 52% of the specimens were  $\geq 2.0$ cm in length.
- Ahlstrom KH, Astrom KGO. CT-guided bone biopsy performed by means of a coaxial biopsy system with an eccentric drill. *Radiology* 1993;188:549-52** 33
- The authors describe a 32 patient study in which a makeshift bone biopsy system, that included a power drill, was used to obtain the bone marrow sample. Successful samples were obtained in 43% of the 37 cases.
- Birch CD, Fischer S, Zibell A, Jensen ME. Diagnostic bone-marrow studies extended routinely by iliac crest biopsy, using the method of Schaadt-Fischer. *Acta Pathol Microbiol Immunol Scand* 1982;90:229-34** 35
- This article describes a study involving 129 bone marrow biopsy procedures using Schaadt-Fischer needles and technique. Authors concluded that using the technique makes it possible to obtain adequate biopsies in 80 to 90% of all patients.
- Islam A. A new bone marrow biopsy needle with core securing device. *J Clin Pathol* 1982;35:359-64** 36
- The author describes a bone marrow biopsy needle he designed, and the technique for using the needle.
- Knowles S, Hoffbrand AV. Bone-marrow aspiration and trephine biopsy (1). *Br Med J* 1980;281:204-5** 37
- This article (Part 1 of 2) describes bone marrow procedures in general, including techniques, preparation for slides, devices (Jamshidi-Swain), risks, and aftercare.
- Knowles S, Hoffbrand AV. Bone-marrow aspiration and trephine biopsy (2). *Br Med J* 1980;281:280-1** 38
- This article (Part 1 of 2) describes bone marrow procedures in general, including techniques, preparation for slides, devices (Jamshidi-Swain), risks, and aftercare.

# Hematology/Oncology Bibliography

## Devices

**Jamshidi K, Swaim WR. Bone marrow biopsy with unaltered architecture: a new biopsy device. J Lab Clin Med 1971;77:335-42**

39

The authors describe their new biopsy device.

**Ellis LD, Jensen WN, Westerman MP. Needle biopsy of bone and bone marrow. An experience with 1,445 biopsies. Arch Intern Med 1964;114:213-4**

40

The authors describe early study of 1,445 bone marrow biopsy procedures using a modification of the Silverman needle.

# Hematology/Oncology Bibliography

## Harvesting

**Faugere MC, Malluche HH. Comparison of different bone-biopsy techniques for qualitative and quantitative diagnosis of metabolic bone diseases. J Bone Joint Surg Am 1983;65:1314-8**

46

This study compared bone biopsy samples taken using a 3mm diameter Jamshidi needle and 5mm diameter electric drill for qualitative and quantitative study of bone histology. Statistical evaluation of the differences and correlations between histomorphometric parameters was performed; results showed that 3mm diameter samples were sufficient for qualitative diagnosis but were not optimum for the quantitative evaluation of cellular parameters of resorption and formation.

**Smiler D, Soltan M. Bone marrow aspiration: technique, grafts and reports. Implant Dentistry 2006;15(3):229-35**

15

This article describes a technique for obtaining adult stem cells from bone marrow aspirate.

# Hematology/Oncology Bibliography

## Overview

- Abla O, Friedman J, Doyle J. Performing bone marrow aspiration and biopsy in children: Recommended guidelines. Paediatr Child Health 2008;13(6):499-501** 44  
This article provides guidelines for the performance of bone marrow aspiration and trephine biopsies in children. It is intended to be useful for both general pediatricians and pediatric hematologists and oncologists. The departmental procedure and guideline document is included in the publication.
- Smucker JD, Akhavan S, Furey C. Understanding bony safety zones in the posterior iliac crest; an anatomic study from the Hamann-Todd collection. Spine 2010;35(7):725-9** 48  
This article describes the dimensions of the posterior iliac crest region in the human pelvis through analysis of 100 male and female skeletal specimens aged 18 to 80 years. There were no statistically significant differences found between right and left ilia; overall measurements were found to be significantly smaller in women.
- Symington K, Martinez Jr F. Bone marrow procedures move into the 21st century. Oncology NEWS International 2010;19(9)** 54  
Brief history of bone marrow procedures and how the IO approach is revolutionizing the field. Discusses use of OnControl. Conduct of this trial was sponsored by Vidacare Corporation.
- Beall DP. Powered bone access system facilitates faster vertebroplasty procedures. Skeletal Radiology 2011;40:514-5** 55  
This abstract describes a clinical evaluation of the Vidacare Bone Access System, used to access the vertebral body for delivery of bone cement during vertebroplasty procedures. Clinicians used the device to perform 43 vertebroplasty procedures on 40 patients. All procedures were successful and there were no complications. Conduct of this trial was sponsored by Vidacare Corporation.  
*Abstract*
- Wilkins BS. Pitfalls in bone marrow pathology: avoiding errors in bone marrow trephine biopsy diagnosis. J Clin Pathol 2011. doi:10.1136/jcp.2010.080838** 58  
Description of steps necessary and common errors to avoid for correct reporting of bone marrow trephine specimens.
- Cheson BD, Horning SJ, Coiffier B, Shipp MA, Fisher RI, Connors JM, et al. Report of an international workshop to standardize response criteria for Non-Hodgkin's Lymphomas. J Clin Oncol 1999;17(4):1244-53** 65  
In an attempt to develop standardization among clinicians, lymphoma investigators from NCI formed cooperative groups and established a consensus on a standardized set of guidelines for response assessment in adult patients with indolent and aggressive NHL. This document was subsequently reviewed and approved by European lymphoma experts.
- Parapia LA. Trepanning or trephanes: a history of bone marrow biopsy. British Journal of Haematology 2007;139:14-9** 13  
This article provides overview of history of bone marrow biopsy procedures; includes descriptions and illustrations of antique and modern biopsy devices.
- Trewhitt KG. Bone marrow aspiration and biopsy: collection and interpretation. ONF 2001;28(9):1409-17** 30  
The authors described the role of oncology nurse practitioners in the performance of bone marrow procedures; and discusses the indications and diagnostic value of the procedures
- Knowles S, Hoffbrand AV. Bone-marrow aspiration and trephine biopsy (1). Br Med J 1980;281:204-5** 37  
This article (Part 1 of 2) describes bone marrow procedures in general, including techniques, preparation for slides, devices (Jamshidi-Swain), risks, and aftercare.

# Hematology/Oncology Bibliography

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**Knowles S, Hoffbrand AV. Bone-marrow aspiration and trephine biopsy (2). Br Med J 1980;281:280-1**

38

This article (Part 1 of 2) describes bone marrow procedures in general, including techniques, preparation for slides, devices (Jamshidi-Swain), risks, and aftercare.

**Brody JI, Finch SC. Bone marrow needle biopsy. The American Journal of Medical Sciences 1959:140-5**

41

This article describes early 100-patient study of bone marrow procedures. Procedure and technique is described in great detail. With focus on patients undergoing biopsies, investigators concluded that the method is simple, safe and convenient for patients; and that the method will replace surgical procedures for obtaining bone marrow biopsies.

# Hematology/Oncology Bibliography

## Pain Management

- Berenson JR, Yellin O, Blumenstein B, Bojanower D, Croopnick J, Abouafia D, et al. Using a powered bone marrow biopsy system results in shorter procedures, causes less residual pain to adult patients, and yields larger specimens. Diagnostic Pathology 2011;6:23** 45
- This article outlines the 102 patient, multi-center, randomized, controlled trial comparing the powered OnControl system to the standard manual technique in community-based cancer clinics. Thirteen device operators from 10 sites participated. Procedure time was significantly less for the powered device ( $102.1 \pm 86.4$  seconds) compared to the manual device ( $203.1 \pm 149.5$  seconds;  $p < 0.001$ ). One day following the procedure more patients were pain-free from the powered group (67%) than the manual group (33%); sample volume was larger for the powered group ( $36.8 \text{ mm}^3 \pm 21.2$ ) than the manual group ( $20.4 \text{ mm}^3 \pm 9.0$ ;  $p = 0.039$ ). Conduct of this trial was sponsored by Vidacare Corporation.
- Park SH, Bang SM, Nam E, Cho EK, Shin DB, Lee JH, et al. A randomized double-blind placebo controlled study of low-dose intravenous lorazepam to reduce procedural pain during bone marrow aspiration and biopsy. Pain Medicine 2008;9(2):249-52** 47
- This study evaluated the efficacy of IV lorazepam, 1mg, as premedication for bone marrow aspiration and biopsy procedures. 138 patients were enrolled, all received local 1% lidocaine and either lorazepam or placebo just before the procedure. Outcome measures included a questionnaire to determine patient perception of the procedure and pain assessments at baseline, just following the procedure, and the next day using a 10cm VAS. Results: IV lorazepam, 1mg, provides no reduction in pain associated with bone marrow aspiration biopsy procedures; more patients receiving the lorazepam reported they were more likely to agree to a second bone marrow procedure.
- Ruegg TA, Curran CR, Lamb T. Use of buffered lidocaine in bone marrow biopsies: A RCT: Theoretical Framework. Oncology Nurse Forum 2009;36(1):52-60** 62
- A double-blind, randomized crossover study in which 48 patients received bilateral bone marrow biopsy procedures, one side with buffered lidocaine and one side with unbuffered lidocaine. Results showed that using 100 mm VAS (visual analog scale) pain scale, patients reported significantly lower pain scores on the buffered lidocaine side than the unbuffered lidocaine side.
- Berenson JR, Yellin O, Blumenstein B, Philbeck T. Rotary-powered bone marrow access results in shorter procedure time, larger core specimens and less residual pain for patients. J Vasc and Interv Radiol 2011;22(3):S15** 64
- This abstract describes the 102 patient, multi-center, trial comparing the powered OnControl system to the standard manual technique. Results showed procedure time was significantly less, more patients were pain free one day following the procedure, and sample volume was larger for the powered group. This trial was sponsored by Vidacare Corporation.
- Abstract (Oral Presentation at 2011 SIR)*
- Berenson J, Yellin O, Bojanower D et al. A Multicenter Randomized Clinical Trial Comparing a Powered Bone Marrow Biopsy System and Manual Bone Marrow Biopsy Procedures. Blood 2010;116(21):1571** 4
- This abstract describes a 102-patient multicenter randomized clinical trial that was designed to determine if a new powered bone marrow sampling device has advantages over traditional manually-inserted needles in terms of decreased pain, decreased procedure time, higher biopsy core capture rate, ease of use, improved sample yield, and higher operator satisfaction scores. Results suggest use of the powered bone marrow biopsy device markedly shortens the procedure time and reduces intermediate-term pain—important considerations for the quality of life for patients undergoing this procedure.
- Abstract*
- Cohen SC, Soroka JM. Evaluation of a powered intraosseous device for bone marrow sampling. Biology of Blood and Marrow Transplantation 2008;14(2) s2:61. Abstract 162** 8
- This abstract describes an observational study designed to evaluate the ability of a new powered bone marrow aspiration device to obtain bone marrow samples. Mean needle insertion time was significantly lower than previously reported. Findings suggested the device is safe and effective.
- Cohen SC, Soroka JM. Evaluation of a powered intraosseous device for bone marrow sampling. Blood 2007;110. Abstract 5150** 11
- This abstract describes an observational study designed to evaluate the ability of a new powered bone marrow aspiration device to obtain bone marrow samples. Mean needle insertion time was significantly lower than previously reported. Findings suggested the device is safe and effective.

# Hematology/Oncology Bibliography

## Pain Management

**Kuball J, Schuz J, Gamm H, Weber W. Bone marrow punctures and pain. *Acute Pain* 2004;6:9-14**

17

This article describes a 263 patient study in which patients receiving bone marrow procedures were evaluated for pain. Substantial pain was reported by 30.4% of patients, but physicians did not realize the pain was felt in more than 50% of the cases. Duration of the procedure was identified as the sole independent predictive factor for patients' pain intensity.

**Miller L, Philbeck T, Montez D et al. Comparing Powered Bone Marrow Biopsy Procedures to Manual Bone Marrow Biopsy Procedures Using Healthy Volunteers. *Blood* 2010;116(21):648**

2

This abstract describes a 24-subject/48-biopsy specimen study designed to determine if the powered bone-marrow biopsy device has advantages over traditional manual devices in terms of decreased pain, insertion time, and improved sample yield. Results suggest the superior size and overall quality of core specimens delivered by the powered device may provide more material for pathological evaluation of hematopoietic and oncological disorders. The powered device was significantly faster in obtaining a biopsy than the manual device and its capture rate in obtaining a satisfactory sample was much higher. Use of the powered device significantly decreases overall procedure pain.

**Swords A, Anguita J, Higgins RA et al. A New Rotary Powered Device for Bone Marrow Aspiration and Biopsy Yields Superior Specimens with Less Pain: Results of a Randomized Clinical Study. *Blood* 2010;116(21):650-1**

3

This abstract describes a 50-patient study that compared the powered device to the traditional manual technique by relatively assessing pain scores, procedure times, biopsy capture rates, quality of material retrieved, safety and operator satisfaction. Results suggest that the use of a powered bone marrow biopsy device significantly reduces needle insertion pain. Moreover, the superior size and overall quality of core specimens retrieved by the powered device provides more material for pathologic evaluation, thereby increasing diagnostic yield and reducing the need for repeat procedures.

**Iannalfi A, Bernini G, Caprilli S, Lippi A, Tucci F, Messeri A. Painful procedures in children with cancer: comparison of moderate sedation and general anesthesia for lumbar puncture and bone marrow aspiration. *Pediatr Blood Cancer* 2005;45:933-8**

19

This article describes a study comparing moderate sedation to general anesthesia in the management of frequently performed lumbar puncture or bone marrow aspiration during cancer treatment for children. Study suggests moderate sedation compared favorably with general anesthesia.

# Hematology/Oncology Bibliography

## Pathology

- Winfield DA, Polaczar, SV. Bone marrow histology 3: Value of bone marrow core biopsy in acute leukemia, myelodysplastic syndromes, and chronic myeloid leukemia. Journal of Clinical Pathology 1992;45:855-9** 42
- This article examines the role bone marrow aspirate and core biopsy play in diagnosis and regular monitoring of acute myeloblastic leukemia (AML), megakaryoblastic leukaemia and acute myelofibrosis, acute lymphoblastic leukemia (ALL), myelodysplastic syndromes (MDS), and chronic myeloid leukemia (CML). The authors conclude that a core biopsy specimen complements the peripheral blood and marrow aspirate findings in providing additional information for the diagnosis and assessment of prognosis.
- Lee SH, Erber WN, Porwit A, Tomonaga M, Peterson LC. ICSH guidelines for the standardization of bone marrow specimens and reports. International Journal of Laboratory Hematology 2008;30:349-64** 43
- The International Council for Standardization in Hematology (ICSH) formed a Working Party for the standardization of bone marrow specimens and reports to prepare a set of guidelines based on preferred best practices. The guidelines were reviewed by an international panel of experts and addresses the procedure from indications for bone marrow examination to reporting results and storage of specimens.
- Abla O, Friedman J, Doyle J. Performing bone marrow aspiration and biopsy in children: Recommended guidelines. Paediatr Child Health 2008;13(6):499-501** 44
- This article provides guidelines for the performance of bone marrow aspiration and trephine biopsies in children. It is intended to be useful for both general pediatricians and pediatric hematologists and oncologists. The departmental procedure and guideline document is included in the publication.
- Berenson JR, Yellin O, Blumenstein B, Bojanower D, Croopnick J, Aboulafia D, et al. Using a powered bone marrow biopsy system results in shorter procedures, causes less residual pain to adult patients, and yields larger specimens. Diagnostic Pathology 2011;6:23** 45
- This article outlines the 102 patient, multi-center, randomized, controlled trial comparing the powered OnControl system to the standard manual technique in community-based cancer clinics. Thirteen device operators from 10 sites participated. Procedure time was significantly less for the powered device ( $102.1 \pm 86.4$  seconds) compared to the manual device ( $203.1 \pm 149.5$  seconds;  $p < 0.001$ ). One day following the procedure more patients were pain-free from the powered group (67%) than the manual group (33%); sample volume was larger for the powered group ( $36.8 \text{ mm}^3 \pm 21.2$ ) than the manual group ( $20.4 \text{ mm}^3 \pm 9.0$ ;  $p = 0.039$ ). Conduct of this trial was sponsored by Vidacare Corporation.
- Faugere MC, Malluche HH. Comparison of different bone-biopsy techniques for qualitative and quantitative diagnosis of metabolic bone diseases. J Bone Joint Surg Am 1983;65:1314-8** 46
- This study compared bone biopsy samples taken using a 3mm diameter Jamshidi needle and 5mm diameter electric drill for qualitative and quantitative study of bone histology. Statistical evaluation of the differences and correlations between histomorphometric parameters was performed; results showed that 3mm diameter samples were sufficient for qualitative diagnosis but were not optimum for the quantitative evaluation of cellular parameters of resorption and formation.
- Bishop PW, McNally K, Harris M. Audit of bone marrow trephines. Journal of Clinical Pathology 1992;45:1105-8.** 50
- This article describes an evaluation of 767 trephines performed at The Christie Hospital, Manchester from June 1, 1990- May 31, 1991, to establish criteria for adequacy for bone marrow trephine biopsy specimens and audit institutional performance.
- Garrett TJ, Gee TS, Lieberman PH, McKenzie S, Clarkson BD. The role of bone marrow aspiration and biopsy in detecting marrow involvement by nonhematologic malignancies. Cancer 1976;38(6):2401-3** 51
- This abstract describes the review of records at Memorial Sloan-Kettering Cancer Center evaluating biopsy and aspirate testing. Supports both aspiration and biopsy are indicated for full evaluation of bone marrow in cancer patients.
- Abstract*
- Musolino A, Guazzi A, Nizzoli R, Panebianco M, Mancini C, Ardizzoni A. Accuracy and relative value of bone marrow aspiration in the detection of lymphoid infiltration in non-Hodgkin lymphoma. Tumori 2010;96:24-7.** 52
- This article evaluates the correlation between bone marrow aspirate and biopsy results in 51 patients with NHL that received both procedures simultaneously. They found that the agreement level was 80% for this patient population, with discrepancies in 20% of cases evaluated.

# Hematology/Oncology Bibliography

## Pathology

- Pileri S, Poggi S, Baglioni P, Montanari M, Sabattini E, Galieni P, et al. Histology and immunohistology of bone marrow biopsy in multiple myeloma. Eur J Haematol Suppl 1989;51:52-9** 53  
Fixed biopsy samples from 125 multiple myeloma patients were reviewed according to morphological and immunohistological criteria. Comparison of the findings of biopsies and aspirates, the aspirate sample lead to an underestimation of the tumor burden in 30% of cases.  
*Abstract*
- Graf BL, Korte W, Schmid L, Schmid U, Cogliatti SB. Impact of aspirate smears and trephine biopsies in routine bone marrow diagnostics: a comparative study of 141 cases. Swiss Med Wkly 2005;135:151-9.** 56  
Compares the diagnostic impact of bone marrow cytology in combination with flow cytometry analysis of aspirate smears and bone marrow histology together with immunohistochemical examination of trephine biopsies. Diagnoses between aspirate and biopsy were concordant in 80.5% cases.
- Reid MM, Roald B. Adequacy of bone marrow trephine biopsy specimens in children. J Clin Pathol 1996;49:226-9** 57  
Evaluation of 822 biopsy specimens for adequacy, collected from children with neuroblastoma over five years, from 25 centers. Found that 17% of biopsy specimens collected were inadequate.
- Wilkins BS. Pitfalls in bone marrow pathology: avoiding errors in bone marrow trephine biopsy diagnosis. J Clin Pathol 2011. doi:10.1136/jcp.2010.080838** 58  
Description of steps necessary and common errors to avoid for correct reporting of bone marrow trephine specimens.
- Bearden JD, Ratkin GA, Coltman CA. Comparison of the diagnostic value of bone marrow biopsy and bone marrow aspiration in neoplastic disease. J Clin Pathol 1974;27:738-40** 59  
Evaluation of 205 simultaneously collected bone marrow biopsy and aspirate specimens from patients with lymphoma, leukemia, and a variety of solid tumors. Specimens were evaluated for adequacy, number of positive biopsies, and disparity between biopsy and aspirate.
- Campbell JK, Matthews JP, Seymour JF, Wolf MM, Juneja SK. Optimum trephine length in the assessment of bone marrow involvement in patients with diffuse large cell lymphoma. Annals of Oncology 2003;14:273-6** 60  
Evaluation of the relationship between length of trephine sample and the number of positive cases, in 172 patients with diffuse large cell lymphoma (DLCL). Found that likelihood of positive diagnosis was related to trephine length with no additional benefit noted for bilateral biopsies; examining serial biopsy sections from a single side can provide sufficient diagnostic information.
- Howard MR, Taylor PRA, Lucraft HH, Taylor MJ, Proctor SJ. Bone marrow examination in newly diagnosed Hodgkin's disease: current practice in the United Kingdom. British J of Cancer 1995;71:210-2** 61  
Results of a questionnaire study sent to UK hematologists and oncologists shows that hematologists were significantly more likely to perform routine bone marrow examination in all patients, including newly diagnosed Hodgkin's patients, than oncologists. This suggests that many patients are undergoing an invasive procedure with minimal chance of the results influencing their management.
- Berenson JR, Yellin O, Blumenstein B, Philbeck T. Rotary-powered bone marrow access results in shorter procedure time, larger core specimens and less residual pain for patients. J Vasc and Interv Radiol 2011;22(3):S15** 64  
This abstract describes the 102 patient, multi-center, trial comparing the powered OnControl system to the standard manual technique. Results showed procedure time was significantly less, more patients were pain free one day following the procedure, and sample volume was larger for the powered group. This trial was sponsored by Vidacare Corporation.  
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In an attempt to develop standardization among clinicians, lymphoma investigators from NCI formed cooperative groups and established a consensus on a standardized set of guidelines for response assessment in adult patients with indolent and aggressive NHL. This document was subsequently reviewed and approved by European lymphoma experts.

# Hematology/Oncology Bibliography

## Pathology

- Bartl R, Frisch B, Burkhardt R, Gettner G, Mahl G, Fateh-Moghadam A, et al. Assessment of bone marrow histology in the malignant lymphomas (non-Hodgkin's): correlation with clinical factors for diagnosis, prognosis, classification and staging. Brit J of Haematol 1982;51:511-30** 66
- A retrospective evaluation of bone marrow biopsies from 678 untreated patients with established malignant NHL to determine the incidence of bone marrow involvement, test independent prognostic relevance of marrow histology, classify bone marrow findings using Lennert's classification, and analyze the mode of spread of malignant lymphoma in marrow to determine staging criteria.
- Morra E, Lazzarino M, Castello A, Dinverardi D, Coci A, Pagnucco G. Bone marrow and blood involvement by non-Hodgkin's lymphoma: A study of clinicopathologic correlations and prognostic significance in relationship to the Working Formulation. Eur J Haematol 1989;42:445-53** 67
- The objective of this study was to determine the clinicopathologic correlations and impact on survival of bone marrow and peripheral blood involvement in a series of 172 cases of NHL. Results showed that the overall incidence of blood involvement by lymphoma was 28.5%; blood involvement correlated with splenomegaly, bulky disease, advance clinical stage, and extent of bone marrow infiltration.
- Berenson J, Yellin O, Bojanower D et al. A Multicenter Randomized Clinical Trial Comparing a Powered Bone Marrow Biopsy System and Manual Bone Marrow Biopsy Procedures. Blood 2010;116(21):1571** 4
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- This abstract describes a 24-subject/48-biopsy specimen study designed to determine if the powered bone-marrow biopsy device has advantages over traditional manual devices in terms of decreased pain, insertion time, and improved sample yield. Results suggest the superior size and overall quality of core specimens delivered by the powered device may provide more material for pathological evaluation of hematopoietic and oncological disorders. The powered device was significantly faster in obtaining a biopsy than the manual device and its capture rate in obtaining a satisfactory sample was much higher. Use of the powered device significantly decreases overall procedure pain.
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