Safety of Lumbar Puncture for Children With Acute Lymphoblastic Leukemia and Thrombocytopenia

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Context Patients with thrombocytopenia are at risk for spontaneous or procedure-related hemorrhage. Whether such patients can safely undergo lumbar puncture (LP) without prophylactic platelet transfusion is unknown.

Objective To determine whether an association exists between thrombocytopenia and LP complications among children with acute lymphoblastic leukemia.

Design, Setting, and Patients Retrospective review of the records of 958 consecutive children (median age, 5.5 years) with newly diagnosed acute lymphoblastic leukemia who were treated at a pediatric cancer center between February 1984 and July 1998.

Interventions All patients underwent a diagnostic LP followed by a median of 4 LPs to instill intrathecal chemotherapy.

Main Outcome Measure Serious complications of LP occurring during the remission induction and consolidation treatment periods (when thrombocytopenia is likely to occur), defined as any neurologic, infectious, or hemorrhagic problems related to the procedure, reported by platelet count at the time of the procedure.

Results Of the 5223 LPs evaluated, 29 were performed at platelet counts of 10 × 10^9/L or less, 170 at platelet counts of 11 to 20 × 10^9/L, and 742 at platelet counts of 21 to 50 × 10^9/L. No serious complications were encountered, regardless of the platelet count. The 95% confidence interval for the proportion of serious complications in the 199 patients with platelet counts of 20 × 10^9/L or less was 0% to 1.75% and that for the 941 patients with platelet counts of 50 × 10^9/L or less was 0% to 0.37%.

Conclusions In our study of children undergoing remission induction or consolidation therapy for acute lymphoblastic leukemia, serious complications of LP were not observed, regardless of platelet count. Prophylactic platelet transfusion is not necessary in children with platelet counts higher than 10 × 10^9/L. Due to the small number of patients in our study with platelet counts of 10 × 10^9/L or less, conclusions cannot yet be drawn for such patients.

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before LP for children with acute lymphoblastic leukemia (ALL) at our center, we could determine whether an association exists between LP complications and thrombocytopenia.

**METHODS**

From February 1984 to July 1998, 958 children with newly diagnosed ALL were treated on 4 consecutive protocols at St Jude Children’s Research Hospital, Memphis, Tenn. The 524 boys (55%) and 434 girls (45%) ranged in age from 1 month to 18 years (median, 5.5 years). Eighty-three percent were white, 13% were black, and 4% were of other races. All patients received induction chemotherapy that included prednisone, asparaginase, vincristine sulfate, daunorubicin hydrochloride, etoposide (or teniposide), and cytarabine with or without methotrexate. In addition to the diagnostic LP, patients received 2 to 9 (median, 4) LPs during the study period for administration of intrathecal chemotherapy (methotrexate, hydrocortisone sodium succinate, and cytarabine). Several types of caregivers performed LPs: pediatric oncologists, pediatric oncology fellows, pediatric residents, and nurse practitioners.

For each day during induction and consolidation therapy on which a patient underwent LP, we recorded the platelet count, number of red blood cells per high-powered microscopic field in the cerebrospinal fluid (CSF), and any platelet transfusion given. We reviewed progress notes for complications at each level of platelet count. For 199 procedures performed at platelet counts at 20 × 10^9/L or below, the 95% CI for the proportion of serious complications was 0% to 1.73%. Traumatic LP occurred in 548 procedures (10.5%) but was not associated with adverse sequelae and, therefore, was not itself considered a complication. Complications were also not encountered in the 208 LPs excluded from analysis.

**RESULTS**

During the review period, 958 children underwent 5442 LPs. One patient was excluded because of early death from sepsis before initiation of intrathecal therapy and another because intracranial hemorrhage at the time of diagnosis resulted in grossly bloody CSF at each of 11 LPs performed to relieve pressure. Another 208 LPs were excluded because no platelet count was determined within 1 day of LP (n = 41) or because no platelet count was documented after administration of prophylactic platelet transfusion (n = 167). No CSF results were reported for 14 LPs, but these procedures were included because patients were evaluable for complications. Therefore, 956 patients underwent 5223 evaluable LPs, of which 895 were done at diagnosis.

No serious complications were associated with any of the 5223 evaluable LPs, but this does not mean that the probability of adverse events is zero. The TABLE shows the upper bounds for the frequency of potential complications according to platelet count. For 199 procedures performed at platelet counts at 20 × 10^9/L or below, the 95% CI for the proportion of serious complications was 0% to 1.73%. Traumatic LP occurred in 548 procedures (10.5%) but was not associated with adverse sequelae and, therefore, was not itself considered a complication. Complications were also not encountered in the 208 LPs excluded from analysis.

**COMMENT**

This study suggests that serious complications are rarely associated with LP in children with ALL and thrombocytopenia. Serious nonhemorrhagic complications of LP include vertebral disk infection or collapse, paraplegia, cranial nerve dysfunction, spinal nerve root herniation, meningitis, and cerebellar tonsill herniation. Serious hemorrhagic complications of LP include spinal subdural, subarachnoid, and epidural hematoma, which have been thought to occur at higher rates in patients with coagulopathy, those treated with anticoagulant or antiplatelet therapy, those who have experienced a difficult or traumatic LP, or those with thrombocytopenia. The risk of complications increases when several risk factors are present. In this study, no serious complications occurred after 5223 LPs (95% CI, 0%-0.07%), 895 of which were performed at diagnosis, when platelet counts were 10 × 10^9/L or less in 11 cases, 20 × 10^9/L or less in 67, and 50 × 10^9/L or less in 306.

Because spontaneous spinal hemorrhage has been reported in patients with hemophilia or those treated with anticoagulant or thrombolytic agents, an increased risk of hemorrhage in these patients after LP is not surprising. Although coagulopathy occurs in 3% of children at the time of the initial diagnosis of ALL, it is generally subclinical, and only 6 patients in this study were given fresh frozen plasma or cryoprecipitate on the day of LP. In a case-control study of 684 adults undergoing LP, Ruff and Dougherty compared rates of serious complications in patients treated with systemic administration of heparin after the procedure with those of controls not treated with heparin. Serious complications (paraparesis or severe
LP FOR CHILDREN WITH THROMBOCYTOPENIA

back or lumbosacral radicular pain lasting for more than 48 hours) occurred in 6.7% of the heparin group and in 1.8% of the control group. In the heparin group, the complication rate was higher if the LP was grossly bloody, if heparin therapy was started within 1 hour after LP, or if concurrent aspirin therapy was administered. Traumatic LP but not aspirin therapy was associated with a higher incidence of complications in the control group, suggesting that platelet dysfunction may not be an independent risk factor for LP complications.

Thrombocytopenia has been associated with complications of LP in individual cases. Owens et al reviewed 33 cases of spinal hematoma after LP, of which 9 had no hemorrhagic risk factors, although 7 of them had a difficult or bloody LP. Twenty-four patients had 1 or more hemorrhagic risk factors: 13 patients had received anticoagulants; 1 had prolonged bleeding time of unknown cause; 1 had coagulopathy because of liver disease; 9 had low platelet counts (1 to 44 \times 10^9/L); 2 had been treated with antiplatelet medications; and 7 had elevated prothrombin time or partial thromboplastin time. In addition to these hemorrhagic risk factors, 14 patients had undergone a difficult or grossly bloody LP. This review suggested that any hemorrhagic risk factor might predispose patients to LP complications. However, this review of case reports does not allow determination of the relative risk for complications in these patients compared with patients with normal hemostasis and normal platelet counts.

Some evidence suggests that LP is safe for patients with mild-to-moderate thrombocytopenia. No hemorrhagic complications were observed in 24 women with unsuspected thrombocytopenia (platelet counts of 15 to 99 \times 10^9/L) who received spinal anesthesia or in 24 children with ALL and platelet counts below 50 \times 10^9/L who underwent LP at the time of diagnosis, including 5 patients with platelet counts below 20 \times 10^9/L. Although these small studies preclude any firm conclusion, the fact that 170 procedures were performed at platelet counts of 11 to 20 \times 10^9/L without serious complications in the current study suggests that platelet transfusion is not necessary for patients with platelet counts above 10 \times 10^9/L. Only 29 evaluable procedures were performed at platelet counts of 10 \times 10^9/L or less and only 6 of these at platelet counts of 5 \times 10^9/L or less. Thus, the safety of LP for patients with profound thrombocytopenia (\leq 10 \times 10^9/L) has not been proven. Prophylactic platelet transfusion is considered the standard of care for nonfebrile adults with acute myeloid leukemia and platelet counts of 10 \times 10^9/L or less. However, we do not routinely give prophylactic platelet transfusion before LP in young patients at diagnosis with a platelet count of 10 \times 10^9/L or less requires further study.

CONCLUSIONS

No serious LP complications were found in this review of 5223 procedures performed during remission induction or consolidation therapy for ALL, despite the fact that 941 procedures were performed with platelet counts of 50 \times 10^9/L or less. However, platelet counts were 10 \times 10^9/L or less in only 29 instances. We conclude that children with ALL do not require prophylactic platelet transfusion for LP if the platelet count is greater than 10 \times 10^9/L.

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