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Pharmacist-Psychiatrist Interventions Triggered by Clinical Decision Support System Improve Monitoring of Patients Using Lithium in a General Hospital

To the Editors:

Lithium is one of the cornerstones for the treatment of patients with bipolar disorders and is also used for patients with treatment-resistant depression.[1,2] Lithium has a narrow therapeutic window and a highly variable inter- and intraindividual dose-serum concentration relationship due to many factors influencing lithium pharmacokinetics.[3] Adequate monitoring is even more important during general hospital admission because toxic or subtherapeutic serum lithium concentrations can easily arise due to changes in, for example, pharmacotherapeutic regimen, renal function, and fluid intake. In addition, physicians responsible for drug monitoring during general hospital admission may be insufficiently aware of the necessity of monitoring patients using lithium.

Since 2010, our hospital, a general hospital with 510 beds and no psychiatric ward, uses a clinical decision support system (CDSS) to timely select patients potentially at risk for adverse events. In August 2011, a new CDSS was introduced to minimize the risk of inadequate monitoring of patients using lithium (hereafter lithium CDSS). Every night the lithium CDSS selects all patients newly admitted to the hospital with an active medication order for lithium. The next morning, the hospital pharmacist analyzes these patients for drug interactions, renal function, electrolyte disorders, and other relevant clinical characteristics with the potential to influence lithium treatment. Next, the hospital pharmacist consults the clinical psychiatrist for follow-up in consultation with the treating physician and recommends measurement of the serum lithium concentration.

The aim of this retrospective follow-up study was to investigate whether introduction of pharmacist-psychiatrist interventions triggered by the lithium CDSS improved adequateness of monitoring of patients using lithium compared with usual care, where a clinical psychiatrist was available on request. Medical records were reviewed for patients admitted to our hospital for at least 24 hours between May 2009 and July 2011 (usual care) and between August 2011 and October 2013 (lithium CDSS). The study was approved by the hospital's institutional review board. The primary end point of this study was the percentage of patients being adequately monitored. To define adequate monitoring of lithium treatment, an expert panel consisting of independent psychiatrists, hospital pharmacists, and a nephrologist was consulted. The expert panel defined adequate monitoring as performance of a preventive psychiatric consultation and measurement of the serum lithium concentration, both within 48 hours after admission. The frequency of transmural communication regarding lithium treatment, either by peer consultation during admission or in the discharge letter, and the frequency of actions following divergent serum lithium concentrations (>0.8 or <0.4 mmol/L for patients >65 years and <0.6 mmol/L for patients <65 years) was defined as secondary end point.

Patient characteristics in the lithium CDSS and usual care groups were compared using independent samples t tests, Mann-Whitney U tests, and Pearson χ^2 tests. The strength of the association between the introduction of the intervention and the primary end point was estimated with multivariate Cox regression and expressed as relative risks (RR) with corresponding 95% confidence intervals (95% CIs). Variables with univariate differences ($P \leq 0.05$) between the period before and after introduction were incorporated into a multivariate model. All statistical analyses were performed using IBM SPSS Statistics version 23.

A total of 243 patients were included; 107 received usual care, and 136 were included after introduction of the lithium CDSS. Most patient characteristics were comparable between groups. Divergent serum lithium concentrations were found in 47 (43.9%) patients receiving usual care and 66 (48.5%) of the patients in the CDSS group. The percentages of patients receiving psychiatric consultation during a previous admission (8.4% vs 30.9%; $P < 0.001$) and patients where the CDSS signaled a diminished renal function (13.1% vs 25.7%; $P = 0.02$) were different between groups. The latter can be explained by implementation of the CDSS for renal function in the summer of 2010. Finally, median length of hospital admission was shorter in the lithium CDSS group (5.9 vs 4.6 days; $P = 0.05$).

Primary and secondary end points are shown in Table 1. The frequency of adequate monitoring was higher in the lithium CDSS group (7.5% vs 26.5%; $RR_{adj} = 3.2$; 95% CI, 1.4–7.1). This result was mainly driven by an increase in preventive psychiatric consultations (13.1% vs 39.0%; $RR_{adj} = 2.7$; 95% CI, 1.4–4.9); there was no significant difference in measurements of serum lithium concentrations (43.0% vs 45.6%; $RR_{adj} = 1.1$; 95% CI, 0.7–1.6). Furthermore, transmural communication regarding lithium treatment improved (35.5% vs 52.9%; $RR_{adj} = 1.6$; 95% CI, 1.0–2.5), but interpretation and actions following divergent serum lithium concentrations did not (55.3% vs 65.2%; $RR_{adj} = 1.2$; 95% CI, 0.7–2.0).

DISCUSSION

After implementation of pharmacist-psychiatrist interventions triggered by the lithium CDSS, the percentage of patients being adequately monitored was found to be

TABLE 1. Primary and Secondary End Points

	Usual Care (n = 107)	CDSS (n = 136)	Crude RR (95% CI)	Adjusted RR (95% CI)†
Primary end points				
Serum lithium concentration and preventive psychiatric consultation within 48 h, n (%)	8 (7.5)	36 (26.5)	3.5 (1.6–7.6)*	3.2 (1.4–7.1)*
Serum lithium concentration within 48 h, n (%)	46 (43.0)	62 (45.6)	1.1 (0.7–1.6)	1.1 (0.7–1.6)
Preventive psychiatric consultation within 48 h, n (%)	14 (13.1)	53 (39.0)	3.0 (1.7–5.4)*	2.7 (1.4–4.9)*
Secondary end points				
Transmural communication regarding lithium treatment, n (%)	38 (35.5)	72 (52.9)	1.5 (1.0–2.2)*	1.6 (1.0–2.5)*
Interpretation of/action following divergent lithium concentrations, n (%)	26/47 (55.3)	43/66 (65.2)	1.2 (0.7–1.9)	1.2 (0.7–2.1)

*$P < 0.05$.

†Relative risk was adjusted for variables with univariate differences between groups (psychiatric consultation during previous admission, CDSS signal for diminished renal function, and length of admission).

significantly increased. This increase was driven by an increase in preventive psychiatric consultations; there was no difference in serum lithium concentrations measured. The latter may be explained by relatively frequent serum lithium concentration measurements in the control group, especially when compared with outpatient lithium monitoring.[4] Furthermore, after implementation of the lithium CDSS, there was more frequent communication regarding lithium treatment with the patients' ambulant psychiatrists and/or general practitioner.

Literature regarding adequateness of monitoring patients using lithium is scarce and usually describes patients in their home environment[5] or during admission in a psychiatric hospital.[6] Mehvar et al.[7] compared monitoring between a general and a psychiatric hospital and found that serum lithium concentrations were more often measured in a psychiatric hospital, but renal function was more often assessed in a general hospital. Huyse et al[8] propose a guideline stating psychiatric consultation should always be performed in the perioperative period when lithium is used. It is not known whether this is practiced in general hospitals. No recommendations on monitoring patients using lithium during general hospital admission were found in international guidelines. Although the National Institute for Health and Care Excellence guideline for bipolar disorders[9] does contain recommendations on lithium measurements, specific instructions for lithium monitoring during general hospital admission are lacking.

This is the first report describing the effects of interventions based on a CDSS monitoring patients using lithium in a general hospital. Its strength is that these results reflect everyday practice in a medium-sized general hospital, which makes them relatively easy to incorporate into daily clinical practice. Its weakness is its retrospective design. Confounding events, such as implementation of electronic medical records and increased awareness for medication safety in general, could have influenced the data aside from implementation of the CDSS. Visual analysis of the data revealed that the percentage of patients reaching the primary end point started to rise before implementation of the lithium CDSS. However, there was an immediate improvement in the primary end point after implementation of the lithium CDSS, and it continued to rise thereafter. A second limitation is the number of patients; rendering performance of an interrupted time series analysis is not feasible. For the same reason, the effect of the introduction of the CDSS on hard end points, such as serious medical or psychiatric complications regarding lithium use, could not be demonstrated.

In conclusion, pharmacist-psychiatrist interventions triggered by a CDSS are effective in improving adequate monitoring of patients using lithium during admission on a somatic ward. Implementation of a CDSS can therefore be considered as a valuable tool to improve patient safety in this vulnerable group of patients.

AUTHOR DISCLOSURE INFORMATION

The authors declare no conflicts of interest.

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