Home point-of-care international normalised ratio monitoring sustained by a non-selective educational program in children

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Summary

Adverse events related to vitamin K antagonist (VKA) therapy might be reduced by point-of-care international normalised ratio (POC INR) monitoring supported by an education program (EP). Our aim was to evaluate the efficacy of a non-selective VKA paediatric EP (regardless of the social, economic, educational or linguistic levels) by analysing the time spent in the therapeutic range (TTR), VKA adverse events and compliance to treatment, and INR control prescriptions. The EP was modified from the pediatric EP previously described but improved by a specifically devised child-focused game. One hundred four consecutive children (median age 8 years) receiving VKA were included in a standardised EP. Patients were in self-testing, and dose adjustments were made by a single physician for three tolerance ranges according to the underlying disease: [2.5–4], [1.8–3.2], and [1.5–2.5]. The median follow-up was 481 days [70–1,001]. The overall TTR was 81.4% [36–100]. The TTR were 74%, 85.6% and 89% for the ranges [2.5–4], [1.8–3.2], and [1.5–2.5], respectively. These results were sustainable during the study period. Only one serious VKA adverse event was recorded. The median number of POC INR tests was 2.5 [1.6–5.7] INR per patient and month. Patients/families performed POC INR when requested in 86.9% of the cases. More than 90% of the families found the EP supportive and wished to follow a long-term reinforcement program. In conclusion, this non-selective child-focused EP for VKA therapy, strongly supported by our dedicated game, is useful in maintaining efficacy, safety and compliance to anticoagulation and its monitoring.

Keywords
Congenital heart disease/defects, education, anticoagulation, point-of-care INR monitoring, children & adolescents

Introduction

Although the American College of Chest Physicians (ACCP) Evidence-Based Clinical Practice Guidelines emphasise the role of the education of patients receiving vitamin K antagonist (VKA) (1), many adverse events related to VKA therapy are linked to the lack of information that patients received as well as to inadequate supervision by the medical teams (2, 3). Rapid fluctuations in the international normalised ratio (INR) are frequent in children. They might be due to illnesses, variation in concomitant treatments, changes in diet, but also to poor compliance with prescriptions (4). These factors make anticoagulation control more difficult in children receiving VKA therapy than in adults (5). Point-of-care (POC) monitoring in children has proven its accuracy and reliability (6–8). Recent recommendations of the ACCP suggest that INR monitoring with POC be made available where resources make this possible (5). It is of note that anticoagulation management with children using the POC INR in the home setting requires a solid parent/patient education program (EP) (7, 9, 10). Different VKA EPs in children using home POC INR monitoring have been described (10, 11), but they are often selective, considering that self-monitoring is potentially not feasible for half of the patients requiring anticoagulation (12, 13).

Here, we sought to evaluate the efficacy of a non-selective VKA paediatric EP based on group sessions for children and their families by analysing the time spent in the therapeutic range (TTR). The secondary objectives were to determine the compliance with prescriptions for VKA treatment and INR measurements, to record VKA adverse events, and to assess patient satisfaction with this VKA treatment management and with our child-focused EP.
Methods

Population

All consecutive families of children requiring more than three months of VKA treatment were invited to participate in the study between September 2008 and March 2011. Our EP did not select families according to their initial status (with respect to social, economic, mother tongue, or educational levels). This study was reviewed and approved by our ethics committee (Comité de protection des personnes Ile de France III, N° EUDRACT: 2009-A00843–54, CPP Dossier N°: S.C.2715) and informed consent was obtained from all children and/or their guardians.

VKA treatment management

The CoaguChek XS® (Roche Diagnostics, Mannheim, Germany) was used for POC INR home monitoring. The ACCP recommendations were used to initiate VKA therapy and to determine the target INR (5, 14). Stable anticoagulation was defined as three consecutive INRs within the therapeutic range over a period of three weeks.

At home, patients performed self-testing and had to transmit each INR value to the coordinating physician in charge of VKA treatment (FB). The dose adjustment was performed by the coordinating physician supervising the program (FB). Medical assistance was available around the clock for any emergency, patient’s questions and unplanned dose adaptation. All of the unplanned telephone contacts by families for VKA treatment were collected.

The dose adjustment was performed utilizing an algorithm for VKA dosing consistently used in our institution. More precisely, three tolerance ranges were used to adjust VKA dosage. The dose was not changed when the INR was found within the following ranges: [2.5–4] for patients with prosthetic mitral valve replacement (MVR), [1.8–3.2] for patients with aortic (AoVR) or pulmonary valve replacement (PVR), dilated cardiomyopathy, coronary aneurysms following Kawasaki disease, arrhythmia, stroke in cyanotic congenital heart disease or extra-cardiac diseases and finally [1.5–2.5] for patients with total cavo-pulmonary connection (TCPC) and pulmonary arterial hypertension (PAH). A contact by phone was systematically obtained after each INR control even if no change in VKA dosage had to be made and the date of the next INR control was planned. When stable anticoagulation was reached, INR control was planned every two weeks. In case of illness or introduction of concomitant treatment, INR was measured more frequently.

VKA treatment compliance and INR control prescription compliance

VKA treatment compliance was noted at every contact with the family. When one dose of VKA was forgotten, adapted adjustment of the following doses and controls was done and recorded. When the family advanced the date of the INR control, reasons were recorded and qualified as appropriate or not.

VKA-related adverse events

Serious adverse events were defined as confirmed thrombosis and/or bleeding that required medical assessment or intervention. Adverse events related to VKA were defined as minor bleeding or ecchymosis not requiring intervention.

The education program (EP)

The EP was administered in group sessions and was modified from the paediatric EP previously described (7, 9). It included a full-day initial session and several reinforcement sessions. The initial EP session included a one-on-one interview with a member of the EP team focused on the understanding of the child and its family of the disease that motivated VKA treatment. The EP included theoretical and practical training for INR monitoring with a POC INR monitor. Finally, parents and children were required to demonstrate their ability to use the POC INR monitor.

Theoretical and practical skills were evaluated by questionnaires. A POC INR monitor and strips were prescribed for six months if parents were able to perform POC INR on at least two separate occasions and if one member of the family had > 60% correct answers in the questionnaire. Different tools were given to the families at the end of the initial EP session: a personal paediatric VKA notebook to report all INR values, VKA daily doses, and VKA adverse events, an information letter for their general practitioner, and prescriptions for VKA and heparin doses. After the first six months, the prescription of strips was restarted, if families were in agreement with the program. All families were proposed to follow the first reinforcement EP that started at least six months after the initial EP. The main tool used in this reinforcement EP was an educational game that evaluates knowledge of the participants in a fun and playful manner, and provided the families with the skills necessary to react to a range of situations related to VKA treatment in everyday life (15). The questions are conceived and formulated by the educational team about practical life (“real life”) and technical problems of the device (“technical questions”). There are both open and closed (“true or false”) questions. The rules are simple. One member of the medical team runs the game. He gives five “points” to each patient and his family. Each patient plays with a gaming piece and moves forward on a game board. The game leader starts by directing his questions to the child, and if he does not obtain an answer, he can ask the parents. Ideally, the question can be modified until the child or the family finds the right answer (to encourage, rather than discourage). The main quality of the game leader should be the spirit. He has to liven up the party so that families are the most active possible. With each question, the pa-
patients face practical situations that they could deal with in real life and they must give the right answer to gain extra points. All families must answer a minimum of five questions. Sample questions are presented in ▶ Table 1 (to see all questions see Suppl. Data, available online at www.thrombosis-online.com). After each reinforcement EP session, open-ended questionnaires were completed by the families to evaluate their satisfaction with the EP program and with the usefulness of the educational game. All families also participated in a program which aimed at determining the role of genetic factors (VKORC1, CYP2C9 and CYP4F2) in the VKA weekly maintenance dose but this data was not used to adapt VKA dosage in the present study (16).

Agreement between the capillary INR and the laboratory INR

During reinforcement EP session, following successful completion of POC INR, venous blood was collected into Vacutainer tubes (BD Vacutainer System, Paymouth, UK) containing 0.109 M sodium citrate at a ratio of 1.9 for each patient. The venous sample was sent to the laboratory within 1 hour of collection. Platelet-poor plasma was prepared by centrifugation at 2,500 g for 20 minutes at 12°C. The prothrombin time (PT) was performed with Innovin (Siemens, Marburg, Germany) on the ACLTop (Instrumentation Laboratory, Bedford, MA, USA). The result was reported as a laboratory INR with reference to the ISI of the regent, after local ISI determination using AK-Calibrant (Technoclone, Vienna, Austria) according to the World Health Organisation scheme for PT standardisation (17).

Table 1: Sample among 60 questions from the game on VKA-related knowledge. See Suppl. data to see all questions (available online at www.thrombosis-online.com).

<table>
<thead>
<tr>
<th>Real life</th>
<th>Technical questions</th>
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<tr>
<td>&quot;What do you do if your general practitioner prescribes antibiotics to you for an earache?&quot; (answer: “I must undergo an INR 48 hours after the beginning of the treatment.”)</td>
<td>&quot;You should wash your hands with alcohol before using your POC INR monitor. True or false?&quot; (answer: “False. My hands need be washed with soap and hot water only.”)</td>
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<td>&quot;What do you do if you had a mitral valve replacement and your INR stands at 1.9?&quot; (answer: “I must call the nurse for heparin injections and ask my cardiologist for a VKA treatment adjustment.”)</td>
<td>“You can use another pricking pen to make your INR. True or false?” (answer: “False. I must use my own specific pricking pen because the system is specific.”)</td>
</tr>
<tr>
<td>&quot;What do you do if you have a fall while riding your bicycle?&quot; (answer: “I must go to the doctor for clinical examination and make an INR with my POC INR monitor.”)</td>
<td>“Can you use “bleach” to wash the band strip?” (answer: “No, I must wash with cold water and a compress.”)</td>
</tr>
<tr>
<td>&quot;What do you do if you have a headache and an INR at 7?&quot; (answer: “I call my cardiologist rapidly and go to his office or to the emergency unit if he is not there.”)</td>
<td>“You can not use a strip twice. True or false?” (answer: “True, a strip can be used only once.”)</td>
</tr>
<tr>
<td>&quot;Can you practice boxing with your VKA treatment?&quot; (answer: “No, but I can practice sports like swimming, running, cycling. … Combat sports are forbidden.”)</td>
<td>&quot;Your POC INR monitor announced Error “X”. What do you do?&quot; (answer: “I read the information book to understand the meaning of this error.”)</td>
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Statistical analysis

All INRs, including POC INR and laboratory INR, were reported in a clinical and biological data base. The time spent in the therapeutic range (TTR) was determined using the Rosendaal method, i.e. assuming a linear variation between two consecutive INR determinations after the stable anticoagulation was reached (18).

The observance rate was assessed by the difference between the date of POC INR indicated by the pediatrician and the actual date of home INR control. Comparisons of the percent of time in the therapeutic range between subgroups were performed using Wilcoxon rank sum tests. Comparisons of the percent of time above and below the limits of the therapeutic range in each subgroup were performed using paired Wilcoxon signed rank tests.

Agreement between POC INR and laboratory INR was estimated using the calculation of the intra-class correlation coefficient and Bland-and-Altman plot, i.e. the difference between the values of POC INR and laboratory INR were plotted vs. their combined means (19).

Distribution of the quantitative variables was expressed as median [range]. Values of p < 0.05 were considered significant. Statistical analysis was performed with R software (http://cran-project.org).

Results

Characteristics of the patients

During the study period, 110 consecutive children and their families followed the EP with a mean of six families per EP session. Six patients/families who followed the EP were excluded from subsequent analysis because the follow-up of VKA treatment was...
shorter than 60 days. One hundred four patients were analysed for the primary and secondary endpoints.

Patients’ demographic and clinical characteristics are given in Table 2. A third of the children was very young with 37/104 children were less than six years old (35%). Most patients (96%) received VKA treatments for cardiac diseases. Children receiving VKA for dilated cardiomyopathy had left ventricle ejection fraction below 30% and received heart failure specific treatment (20). All patients treated for coronary aneurysms after Kawasaki disease received aspirin as an antplatelet agent (5). Two patients treated for PAH received a combination therapy with sildenafil, bosentan, and treprostinil treatment. Overall, 49/104 patients (47%) had a chronic cardiac treatment associated with VKA.

As shown in Table 2, most of the patients received warfarin (72.1%). Since 2008, all patients naïve for VKA treatment were given warfarin but the patients who were already treated with fluindione or acenocoumarol were left with this VKA. Half of the children (55/104) used the POC INR monitor within the first three months that followed start of VKA treatment (naïve patients), and 49/104 (47%) switched from laboratory monitoring to home monitoring.

Two families stopped POC INR monitoring and preferred standard laboratory testing.

Patients/families performed POC INR when requested in 86.9% of cases; 8.6% of POC INR were performed later than two days after the prescribed date and 4.5% of POC INR were performed earlier than two days before the prescribed date. Anticipation of INR control was appropriate in 86.2% of cases because of concomitant medication (mainly antibiotics) (61.7%), pediatric infectious disease as isolated fever-gastroenteritis (27.9%), minor bleeding (4.8%), hospitalisation (3.8%) and other diverse factors (1.8%).

VKA-related adverse events

During the study period, there was one major bleeding event (incidence of 0.69 per 100 patient-years) consisting of menorrhagia that required transfusion in a 12-year old girl treated with VKA and aspirin after MVR. INR at time of bleeding was 4.3. Twenty-eight minor haemorrhagic complications were recorded: 11 epistaxis, 11

Table 2: Demographics and characteristics of the 104 patients.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Male sex — no of patients (%)</th>
<th>54(52)</th>
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<tbody>
<tr>
<td>Age — years (median [min-max])</td>
<td>8.2 [0.26–17.9]</td>
<td></td>
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<tr>
<td>Age group — no of patients (%)</td>
<td>&lt; 1 year: 6 (5.8)</td>
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<td></td>
<td>1 to 6 years: 31 (29.8)</td>
<td></td>
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<tr>
<td></td>
<td>6 to 12 years: 33 (31.7)</td>
<td></td>
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<td></td>
<td>&gt; 12 years: 34 (32.7)</td>
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<td>VKA type — no of patients (%)</td>
<td>Warfarin: 75 (72.1)</td>
<td></td>
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<tr>
<td></td>
<td>Fluindione: 27 (26)</td>
<td></td>
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<tr>
<td></td>
<td>Acenocoumarol: 2 (1.9)</td>
<td></td>
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<tr>
<td>VKA indications — no of patients (%)</td>
<td>MVR (+ AoVR): 31 (29.8)</td>
<td></td>
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<tr>
<td></td>
<td>AoVR: 14 (13.5)</td>
<td></td>
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<tr>
<td></td>
<td>PVR: 1 (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dilated cardiomyopathy: 13 (12.5)</td>
<td></td>
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<tr>
<td></td>
<td>Arrhythmia: 1 (1)</td>
<td></td>
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<tr>
<td></td>
<td>Stroke with cyanotic congenital heart disease: 2 (1.9)</td>
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<td></td>
<td>Coronary aneurysms after Kawasaki disease: 7 (6.7)</td>
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<td></td>
<td>Extra cardiac diseases: 4 (3.8)</td>
<td></td>
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<td></td>
<td>TCPC: 29 (27.9)</td>
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<td></td>
<td>Pulmonary arterial hypertension: 2 (1.9)</td>
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</table>
| VKA, Vitamin K antagonist; INR, international normalized ratio; MVR, mitral valve replacement; AoVR, aortic valve replacement; PVR, pulmonary valve replacement; TCPC, total cavo-pulmonary connection.

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Table 3: Percent of time in the INR range, above the upper limit, and below the lower limit according to the three ranges.

<table>
<thead>
<tr>
<th>INR range</th>
<th>Percent of time</th>
<th>p-value*</th>
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<tbody>
<tr>
<td></td>
<td>in the range</td>
<td>above the</td>
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<tr>
<td></td>
<td></td>
<td>upper limit</td>
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<tr>
<td>[2.5–4]</td>
<td>74% [48–100]</td>
<td>19.3% [0–36]</td>
</tr>
<tr>
<td>[1.8–3.2]</td>
<td>85.6% [36–98]</td>
<td>6.8% [0–31]</td>
</tr>
<tr>
<td>[1.5–2.5]</td>
<td>89% [57–100]</td>
<td>8.2% [0–39]</td>
</tr>
<tr>
<td>Total</td>
<td>81.4% [36–100]</td>
<td>9.5% [0–39]</td>
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* The p value concerned the comparison of the percent of time above and below the limits of the therapeutic range in each subgroup.

subcutaneous hematomas and six menorrhagias (incidence of 19.2 per 100 patient-years). There was no thromboembolic event during the study period.

Evaluation of knowledge and satisfaction

The results of the theoretical tests at the end of the initial EP session were excellent (median 90/100 [60–100]). A POC INR monitor and strips for six months were prescribed to all patients after the initial training session because none had less than 60/100 on the theoretical tests. All families succeeded in using the POC INR monitor during the EP program. Ninety-five families (91.3%) said that the initial EP helped them live better with the treatment.

Until now, 69/104 families have had at least one reinforcement EP session and have experienced the specifically devised EP game. They showed a very good knowledge of VKA treatment and good reactions to a variety of situations. All patients were able to use the POC INR monitor correctly. A total of 68/69 families (98.5%) found the reinforcement EP sessions very useful and said that the game was a very good educational tool. All patients appreciated the ludic element, the excitement generated by the competitive factor inherent in game practice and the contagious nature of the fun generated among the children in a convivial setting.

A total of 66/69 families (95.6%) would like to have reinforcement EP sessions. A total of 65/69 families (94.2%) were reassured and felt more involved in their child VKA treatment. We compared the answers between naïve and switched patients. All answers were similar except for two. Switched patients asked more for the reinforcement EP sessions than the naïve patients (100% vs. 92%, p=0.03). In the naïve group, patients felt more distress than in the switched group although the difference was not significant (100% vs. 93%, p=0.07). In the switched group, all parents said that the POC monitoring was a good tool, which limits the laboratory constraints, but they thought that the main advantage of this new way to monitor VKA treatment was to participate in the EP.

Agreement between the POC INR and laboratory INR

The intra-class coefficient correlation was 0.97 [0.95–0.98]. When the differences between laboratory INR and POC INR were plotted against their combined means, the plot showed good agreement between the two methods (Fig. 3) with a bias near to 0 (-0.06 ± 0.25). Eight measurements out of 113 (7%) were outside the confidence interval (differences > 0.5). These 8/113 INR showed a difference from 0.5 to 0.8 units between the two methods. Only 3/8 would have resulted in a different clinical management decision (2.7%).

Discussion

The POC INR monitor provides a potential solution to the problem of obtaining frequent, non-traumatic INR in children and to allow regular VKA monitoring which is essential to reduce the risk of hemorrhage or recurrent thrombotic disease in this population (5). The reliability of INR results generated at home has been demonstrated to be dependent on parental knowledge following participation in a solid EP (7). Because of a strong relationship between the TTR and the risk of VKA related adverse events (21, 22), this parameter is often used to assess the quality of oral anticoagulation. In our study, the TTR was 81.4%. This TTR is one of the best obtained in pediatric studies dealing with home INR monitoring (9). Indeed, a review of pediatric studies evaluating the use of POC INR monitors in children identified five studies in which the TTR ranged from 64% to 76% (6). In a recent study in 28 patients managed by a group with a large experience in education for VKA therapy, the TTR observed for patient performing INR self-testing was 83.9% (9). Self-testing promotes patients’ engagement in their own care. Actually, inadequate parental or patient knowledge of congenital cardiac care might contribute to care interruption (23).

Hitherto, a recent review of self-testing and self-management of VKA therapy in children concluded that these methods of VKA management were feasible only in a highly selective population (13). Undeniably, many reports show that a high percentage of patients are excluded from EP for a variety of reasons. In this study, we decided a priori that our EP would be non-selective and would include all families regardless of their social, economic, educational or linguistic levels. We indeed included 9/104 families who poorly spoke French at the beginning of the EP. None of these families quit the EP so far. The same comment should be made for patients who had a very low education level. We showed here that a solid and specific EP allowed almost all patients to follow VKA treatment and self-testing with a POC INR monitor safely.

Proposing user-friendly tools to evaluate parents’ and children’s education and practical skills as well as personalised documents certainly play a role in the success of our non-selective approach. We limited our objectives for the EP to success of the self-testing with an effective system of medical supervision that allowed us to rapidly identify problems after the initial EP session. Following this initial EP session, only two families quit the program and preferred
to go back to standard laboratory testing. For both of them it was
due to personal choice because performing the tests themselves
was considered too stressful, even though they performed it per-
factly. Interestingly, a recent meta-analysis on self-monitoring in
adults showed that young patients were more likely to use self-
monitoring successfully (12).

Of note, compliance with the prescription of VKA dosage was
excellent, and the strip consumption was reasonable. Patients/
families performed POC INR mainly when requested. One of the
key factors in this program was most probably the empowerment
conferred upon the children and their families.

With this EP, the TTR was stable during the whole study period
independent of the INR range ( Fig. 2). This showed the efficacy
of the EP over time. This result suggests that organising reinforce-
ment EP sessions is important in maintaining patients’ education
and compliance. As an example of self-confidence, 33% of pa-
tients/families travelled outside France for the first time after the
EP and kept contact with our medical supervision during their
holidays abroad.

The TTR was the lowest in the group with prosthetic mitral valve,
and this was explained mostly by the time spent above the ther-
peutic range ( Table 3). This may be due to the higher risk of
thrombosis of the valve that becomes undersized with growth and
the low risk of haemorrhage in children that intuitively leads to tol-
erate INR above 4.0 in these patients (13, 24, 25). In patients palliated
with total cavo-pulmonary connection and in those with PAH, the
mean TTR was 89% with no patient with INR below the therapeutic
range. In the last group with tolerance range [1.8–3.2], the TTR was
85.6% and the proportions of INR below and above the limits were
identical ( Table 3). The major bleeding rate was 0.97 per 100 pa-

![Figure 1: Percent of patients according to the time spent in the therapeutic range (TTR). A) All ranges; B) INR [2.5–4]; C) INR [1.8–3.2]; D) INR [1.5–2.5].](https://www.thrombosis-online.com/108.4/2012/art_1066/f1.png)
tient-year and there was no thromboembolic event. The unique major bleeding occurred in a child with a low bleeding risk taking low-dose aspirin and VKA (3). She took also amiodarone for recurrent arrhythmia. Amiodarone reduces the warfarin clearance and potentiates the pharmacodynamic response of warfarin, enhancing the anticoagulant effect (26). However, the number of patients in this study is not sufficient to allow us to conclude on the limitation of VKA-related adverse events with a child-focused EP.

Our results also confirmed the accuracy of the CoaguChek XS® for POC INR measurement in children requiring VKA. Marzinotto et al. showed that the correlation between POC INR and laboratory INR was better when the POC INR were used by trained healthcare professionals compared to patients (27). In our study, the agreement between INR performed with POC monitor by patients and laboratory INR was excellent. It was comparable to that obtained in similar population after a standardised EP that ensures their competence in POC INR self-testing (6, 7). In two previous paediatric studies, the POC INR result was on average 0.1 unit INR below (6) and 0.22 units INR above (8) the corresponding venous INR result. In our study, the average difference between laboratory INR and POC INR was closed to 0 (-0.06 ± 0.25) with none of the two methods showing systematic difference above or below the other method.

In this non selective study, children and their parents, irrespective of the age of the children, were satisfied with the EP. As a third of the children (37/104) was less than six years old and two thirds were less than 12 years old (70/104), we believe that our game was particularly adapted to support the EP. Families and the medical team appreciated this educational game. It allows the team to evaluate not only the patient’s knowledge about his treatment and the practice of self-testing, but also the patient’s adaptability to specific and practical situ-

Figure 2: Distributions of TTR in the different groups of patients over the years 2009 and 2010. A) All ranges; B) INR [2.5–4], 2C: INR [1.8–3.2], 2D: INR [1.5–2.5]. Jan-Jun and Jul-Dec corresponded to the first and second semester of years 2009 and 2010.
ations. It aims to get patients to be active participants, considering that they are often too passive in mere information programs (15, 28). Another major factor to be observed is the empowerment conferred upon the children, and greatly appreciated by them, who see themselves – perhaps for the first time – considered as mature individuals responsible for their own health concerns.

In conclusion, this non-selective dedicated EP led to a massive adhesion of patients and families, a very high compliance to drug, INR control prescriptions and follow-up, and allowed stability of anticoagulation and safety. One of the highlights of this EP for VKA treatment controlled by POC INR self-testing in children was our educational game which focused on testing the knowledge and critical thinking to manage the daily VKA in a fun way.

Acknowledgements

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Conflicts of interest

None declared.

References


What is known about this topic?
- Anticoagulation management with children using the point-of-care international normalised ratio (POC INR) at home requires a solid parent/patient education program.
- Most programs are selective (social, economic or educational levels), considering that self-monitoring is potentially not feasible for half of the patients requiring anticoagulation.

What does this paper add?
- A non-selective VKA education program based on group sessions for children and their families is feasible.
- The efficacy, safety and compliance to anticoagulation and its monitoring are supported by effective medical supervision and by a specifically devised child-focused game.

Abbreviations

EP, education program; VKA, vitamin K antagonist; INR, international normalised ratio; POC, point-of-care; MVR, mitral valve replacement; AoVR, aortic valve replacement; PVR, pulmonary valve replacement; TCPC, total cavopulmonary connection; ACCP, American College of Chest Physicians Evidence-Based Clinical Practice Guidelines.


