Should warfarin be discontinued before a dental extraction?  
A decision-tree analysis

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Objective. The aim of this study was to determine if warfarin should be withdrawn before a single tooth extraction on a patient with a prosthetic heart valve.

Study design. A quantitative decision tree was constructed to assess the expected utility values of 2 typical strategies to manage the dental extraction on a patient currently medicated with warfarin. Probabilities and utilities for a cardiovascular accident and major bleeding from a dental extraction were taken from the literature.

Results. The decision slightly favors withholding warfarin: generating an optimal expected utility value of 0.976 utile. This was only 0.02 utile higher than the alternative option of continuing warfarin for a dental extraction.

Conclusion. The decision to withhold or continue warfarin before a dental extraction depends more on the relative risk of a major bleeding between the 2 medical management strategies than on the consequences of a cardiovascular accident. (Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2010;110:691-697)
One can think of the utile as the proportional value judgment a patient or decision maker places on a nonideal health state relative to the ideal health state (having a value of 1 utile) and death (having a value of 0 utile). For example, a utility of .75 utile implies a health state perceived to be about 75% of ideal.13

Dunn et al. published a DTA on the medical management of patients on oral anticoagulants slated for dental extraction.17 However, their analysis considers the decision of the preoperative withdrawal of oral anticoagulants and replacing with heparin versus the decision of not withdrawing the oral anticoagulant before a dental extraction. In the typical outpatient private dental practice, bridging therapy with heparin is not a practical option.

Therefore, the objective of the present paper is to apply quantitative DTA to a common clinical question confronting dentists in practice: Should oral anticoagulants be withdrawn or not before a dental extraction in patients with a history of a prosthetic heart valve and an international normalized ratio (INR) of <4?

**METHODOLOGY**

**Decision tree construction**

The decision tree model (Fig. 1) depicts the possible outcomes for dental extraction in warfarinised patients. The tree illustrates the decision-making process, considering various outcomes such as mild, moderate, severe CVA events, and death. It also accounts for major bleeding and non-fatal bleed scenarios. The model is designed to help in making informed decisions based on the outcomes of different scenarios during dental extraction.

**Fig. 1.** Decision tree for the medical management of the oral warfarinised patient scheduled for a dental extraction. (The square box indicates decision node, chance nodes are depicted by circles and the final outcome nodes are shown as triangles. CVA refers to Cardio-Vascular-Accident. Refer to textbooks on healthcare decision making for a further explanation on the construction of decision trees. [15,16]).
outcomes of 2 preextraction approaches of managing a
dental patient’s warfarin medication. The hypothetical
clinical scenarios of the extraction of a single tooth on
a 60-year-old patient with a medical history of a pros-
thetic heart valve and a pretreatment INR of <4 were
analyzed using this model.

When such a patient is scheduled for dental extrac-
tions, the dentist must decide between instructing the
patient to continue with their regular warfarin medica-
tion or instructing them to withhold their warfarin reg-
imen for 2 days before dental surgery. Then the patient
is told to start their medication immediately after the
dental extraction. The option to withhold warfarin as-
sumes that the patient is still anticoagulated (i.e., ther-
apeutic) for the 2 days up to the moment of extraction.
This implies that the risk of a thrombosis before surgery
is the same between the alternative strategies.17 Both
management strategies present the possibility of a CVA
and its associated levels of complications occurring
after oral surgery with or without the occurrence of
major bleeding. However, it is assumed that a possible
fatal outcome from major bleeding can only occur to
patients still on warfarin during the surgical procedure.
The description of stroke severity is described by Dunn
et al.17

**Determination of outcome probabilities and utilities**

The range and case-base probabilities’ and utilities’
for each outcome are presented in Table I.

The probability of a CVA is based on results of a
literature review conducted by Dunn et al.17 It is as-
sumed that the warfarin-withheld patient is subthera-
peutic just before the extraction and that it takes about
3 days after restarting warfarin for the patient to return
to therapeutic levels. The probability of developing a
stroke for the warfarin-withheld patient for 3 days after
extraction was determined by dividing the annual
stroke rate for a nonanticoagulated patient by 365 days
and then multiplying the result by 3 days. This proba-
ability was reduced by the reported relative risk reduc-
tion to determine the 3-day probability of a stroke for
the warfarin-continued patient.17

The probability of major bleeding on a warfarin-
continued and a warfarin-withheld patient was deter-
dined by a literature search. Pubmed was searched for
articles on December 2, 2009. The following MeSH
and text terms were used: warfarin, anticoagulants,
tooth extraction, oral anticoagulant, and coumadin.
The search was limited to English-language clinical trials,
randomized controlled trials, reviews, and meta-analy-
ses. Only studies that investigated dental extractions in
patients whose warfarin was continued or withheld
were included. Excluded were studies that used adjunc-
tive measures to control hemostasis (i.e., tranexamic
acid, resorbable collagen sponges). Relative risk
(RR)—and associated 95% confidence intervals—of
major bleeding between the warfarin-continued and the
warfarin-withheld patient was calculated from the data
extracted from only 2 studies which met the inclusion/
exclusion criteria (Table II).18,19 The probability of
major bleeding reported by Evans et al.18 was used in
this analysis, because it was a larger study (Table I).

In the mathematical model of this tree, the probabil-
ity of major bleeding on warfarin was a function of the
RR and probability of major bleeding when warfarin
was withheld;

\[
p[\text{major bleed with warfarin}] = p[\text{major bleed with warfarin withheld}] \times RR
\]

There is no reported case of fatal bleeding after
dental extraction in a patient with warfarin. However,
fatal bleeding of 1% has been reported in patients with
anticoagulants who underwent other types of sur-
gery.20 For the sake of creating balance in this decision

<table>
<thead>
<tr>
<th>Event</th>
<th>Probabilities (%)</th>
<th>Range (%)</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major bleeding after extraction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warfarin</td>
<td>25</td>
<td>25-37</td>
<td>[18,19]</td>
</tr>
<tr>
<td>Warfarin withheld</td>
<td>14</td>
<td>14-25</td>
<td></td>
</tr>
<tr>
<td>Relative risk (RR)*</td>
<td>1.79*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death from major bleeding</td>
<td>1</td>
<td>0-2</td>
<td>[17]</td>
</tr>
<tr>
<td>CVA with prosthetic mitral valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warfarin</td>
<td>7.2</td>
<td>4-12</td>
<td>[17]</td>
</tr>
<tr>
<td>Annual</td>
<td>0.059</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warfarin withheld</td>
<td>1.1</td>
<td>0.9-1.5</td>
<td></td>
</tr>
<tr>
<td>Annual</td>
<td>0.009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk of stroke</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>21.1</td>
<td>10-30</td>
<td>[17]</td>
</tr>
<tr>
<td>Moderate</td>
<td>9.0</td>
<td>5-20</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>39.6</td>
<td>25-40</td>
<td></td>
</tr>
<tr>
<td>Death</td>
<td>30.3</td>
<td>20-35</td>
<td></td>
</tr>
</tbody>
</table>

| Utility (utile)                    |                   |           |              |
| Health (recovery with no complications) | 1                 |           |              |
| Major bleeding                     | 0.841             |           | [21]         |
| CVA                                |                   |           |              |
| Mild                               | 0.76              |           | [17]         |
| Moderate                           | 0.39              |           |              |
| Severe                             | 0.189             |           |              |
| Death                              | 0                 |           |              |

*Not a probability but a ratio calculated from the above data of a major bleeding with warfarin and warfarin-withold.
TABLE II. Summary of reported risk of major bleeding after dental extractions

<table>
<thead>
<tr>
<th>Reference</th>
<th>Major bleeding after extraction</th>
<th>Relative risk [95% CI (calculated)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Mubarak et al.</td>
<td>+W = 37% (n = 51)</td>
<td>1.48 [0.807-2.71]</td>
</tr>
<tr>
<td>(2007)19</td>
<td>−W = 25% (n = 48)</td>
<td></td>
</tr>
<tr>
<td>Evans et al.</td>
<td>+W = 25% (n = 57)</td>
<td>1.79 [0.82-4.17]</td>
</tr>
<tr>
<td>(2002)18</td>
<td>−W = 14% (n = 52)</td>
<td></td>
</tr>
</tbody>
</table>

CI, Confidence interval; +W, warfarin; −W, warfarin withheld.

tree, the risk of a fatal bleed was included in this analysis.22

Sensitivity analyses
A sensitivity analysis is necessary to see how robust the tree’s conclusions are under different levels of uncertainty. One-way sensitivity analyses were conducted on varying the RR of major bleeding and on varying the patient’s perceived utility of major bleeding after a dental extraction.

DTA software
This decision model was analyzed with TreeAge Pro 2009 (TreeAge Software, Williamstown, MA).

RESULTS
Figure 2 presents the detailed DTA with each strategy’s optimal EUV.

The DTA favors the strategy of withholding warfarin; generating an optimal EUV of .976 utile. This is only .02 utile higher than the alternative option of continuing warfarin.

A sensitivity analysis (Fig. 3) demonstrates that the decision threshold occurs with an RR of 1. In other words, the EUVs of the 2 strategies are essentially the same when there is no difference in the risk of major bleeding after a dental extraction on the warfarin-continued and warfarin-withheld patient with a prosthetic valve. An RR > 1 favors withholding warfarin.

Figure 4 shows no effect on the decision when varying the patient’s utility of major bleeding after a dental extraction.

DISCUSSION
All clinical decisions are made in a world of uncertainty. The rational decision maker will choose the course of action that maximizes their net desired expectation (i.e., expected utility value). This expectation is a balance between the chances of success of each strategy and the patient’s perceived value judgment (i.e., utility) of its outcome.

The analysis here found that in a world of uncertainty, the decision slightly favors withholding warfarin from a 60-year-old prosthetic valve patient scheduled for a dental extraction. This is because the risk of a CVA is so small compared with the risk of major bleeding after a dental extraction when the patient is on warfarin. However, if the risk of major bleeding after a dental extraction is equal between the warfarin-continued and warfarin-withheld patients, then either strategy is equally favorable.

Although Evans et al.18 and Al-Mubarak et al.19 reported a higher risk of major bleeding in the warfarinized patient, the difference was not statistically significant. This may be because both studies’ sample sizes did not have the statistical power to show a difference (i.e., type II error).

The utility of major bleeding was taken from a source including major bleeding from surgery but not necessary dental extraction.21 As such, the author may have overestimated or underestimated this value. However, a sensitivity analysis on this issue showed that this had no effect on the final decision.

Despite the fact that there are no reported cases of a fatal bleeding on a warfarin-continued patient after a dental extraction, the present DTA considered its possibility. However, even when the probability of such an event is taken as 0, the EUV of continuing with warfarin is 0.958 utile, which is still below the EUV of withholding warfarin.

The definition of what constitutes major postextraction bleeding is inconsistent in the literature. Nemutalla et al. made reference to this heterogeneity in their systematic review that queried the medical management of warfarin-continued patients scheduled for minor dental surgery. However, they suggested that warfarin not be discontinued before minor oral surgery, because their meta-analysis of the literature found no statistical difference in the risk of a major postextraction bleeding event between the 2 medical management options. This is consistent with the conclusion of the present study’s sensitivity analysis. Nevertheless, a potential flaw with this analysis is with the data used in the model and not the model itself. However, this DTA can be updated in the future as more accurate and up-to-date data for each of the variables in the model become available.

Although the conclusion generated by this analysis is generally in disagreement with the current clinical guidelines by the British Dental Journal10 and Aframian et al.,9 the spirit of this analysis should be appreciated more than the results it generated. For example, Aframian et al. concluded that “for most patients undergoing simple single dental extractions, the morbidity of potential thromboembolic events if anticoagulants therapy is discounted clearly outweighs...
Fig. 2. Decision-tree analysis for the medical management of the oral warfarinised prosthetic-valve patient scheduled for a single-tooth extraction. (Shaded boxes are the EUV of that specific decision node).
CONCLUSION

The decision to withhold or continue warfarin before a dental extraction depends more on the RR of major bleeding between the two medical management strategies than on the consequences of a CVA. For the minimally invasive single tooth extraction, not disrupting the patient’s warfarin protocol and using local adjunctive means of hemostasis is defensible. However, in cases that are significantly invasive and/or involve multiple dental extractions, withholding warfarin may be indicated, because of the risk and thus the negative consequences of major bleeding as perceived by the patient.

REFERENCES


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