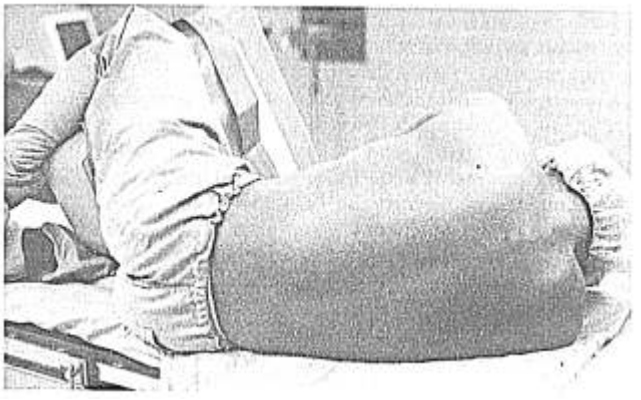

Fig. 1. Suggested regional anesthesia positioning for a patient at risk for dislocation following total hip arthroplasty.

Total hip arthroplasty has become a common reconstructive hip procedure.[1] It is likely that an increasing number of patients with hip prostheses will return to the operating room for other procedures, and simple positioning maneuvers may potentially decrease the incidence of complications such as that described above.

The incidence of hip dislocation following primary THA is approximately 3%,[2] with the greatest risk in the 3 months following operation.[3] Previous hip surgery is an additional risk factor for dislocation following THA; in this setting, the risk of dislocation is approximately 20%.[4] Other factors include medical disorders that produce mental confusion or muscle weakness, concurrent neurologic disease, or faulty positioning of the arthroplastic components.[5] Placing the hip in a position of extreme flexion, internal rotation, and adduction increases the risk of dislocation.[1] For this reason, following THA, a triangular pillow wedge or abduction splint is placed between the thighs to keep the hips abducted and neutrally rotated. The physical activity required to dislocate the hip following THA may be minor, such as rolling over in bed or tying one's shoes. Although the amount of trauma associated with dislocation of the hip following THA is usually minor, most patients will recognize immediately that something is wrong with the hip once dislocated. The vast majority of postoperative hip dislocations can be treated with closed reduction.[6].

The risk factors for hip dislocation in our patient included THA within the past 3 months and previous hip surgery. His hip instability was exacerbated by positioning for his spinal anesthetic, which included hip flexion, adduction, and possibly internal rotation.

As a result of our experience, we believe special caution should be used in regional anesthesia positioning for patients at risk for dislocation following THA. Because these patients may not fully understand the implications of positioning, it is the anesthesiologist's responsibility to protect the unstable hip in this setting. The advantage of spinal and epidural anesthetics administered to patients in the lateral position with minimal flexion of the back, the prosthetic hip nondependent, and an abduction splint or pillow placed between the thighs should be considered (fig. 1). The use of a knee immobilizer also prevents flexion, adduction, and internal rotation by holding the knee in extension.[7] We suggest that these simple maneuvers may decrease the risk of dislocation in patients who have had recent hip arthroplasty.

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Prevention of Awareness during Total Intravenous Anesthesia

To the Editor:—Kelly and Roy[1] recently reported a case of awareness during the administration of propofol as the sole anesthetic. Based upon my understanding of the pharmacokinetic and pharmacodynamic concepts related to intravenous anesthesia,[2–6] it is not surprising that this patient was aware during the surgical procedure.

Simulating the dosing profile administered by Kelly and Roy[1] would

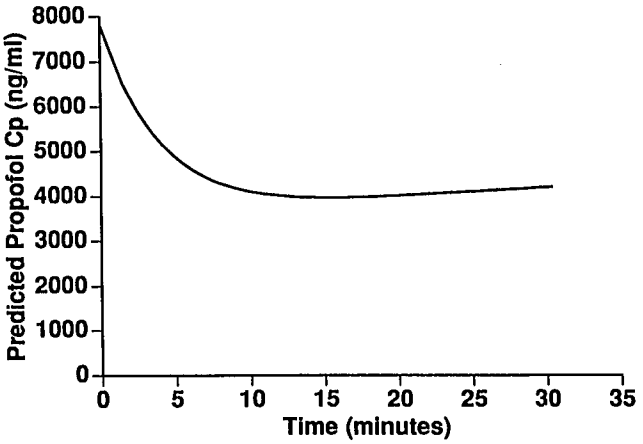

Fig. 1. Computer simulation of the resultant blood propofol concentrations following a 3.5-mg/kg loading (induction) dose followed by a 270-$\mu g \cdot kg^{-1} \cdot min^{-1}$ maintenance infusion.

result in a propofol whole blood concentration during anesthesia of approximately 4 μg/ml (fig. 1). This simulation is based on the pharmacokinetic parameters that we have tested prospectively and have provided a median performance error (bias) of −11.6% and a precision (10–90th percentile of the median performance error) of −45—35%.* The Cp50 for loss of consciousness was reported recently as 3.4 μg/ml and the Cp90 as 4.34 μg/ml.[7] Using a slightly different methodology, we found the Cp50 for loss of response to command as 3.3 μg/ml.[8] Thus the infusion regime used by Kelly and Roy would not have ensured loss of consciousness in all patients. In addition, the Cp50 to prevent a somatic response (*i.e.*, purposeful movement) at skin incision is 15.7 μg/ml[8] and is much higher than Cp50 for loss of consciousness. Even though the patient appeared adequately anesthetized prior to surgical manipulation, the concentration resulting from the administered infusion rate of propofol was insufficient if propofol was to be used as a sole anesthetic during surgery. Thus it is not surprising that using propofol at relatively low concentrations as the sole anesthetic resulted in awareness during surgery.

The addition of an opioid markedly reduces the Cp50 of propofol. A plasma fentanyl concentration of 1 ng/ml (initial bolus of 1 $\mu g/kg$ followed by 1 $\mu g \cdot kg^{-1} \cdot h^{-1}$) reduces the Cp50 of propofol by 63%.[8] Therefore, when an opioid was part of the anesthetic, awareness did not occur in the patients presented by the authors.

The MAC awake for isoflurane (which is akin to the Cp50 asleep) is 30% of its MAC for skin incision.† Nobody would expect to provide adequate anesthesia with 0.4% isoflurane alone. The MAC of isoflurane also is markedly reduced by fentanyl[9] and thus much lower isoflurane concentrations are necessary when isoflurane is combined with an opioid (*i.e.*, the pharmacodynamic principals related to the administration of potent volatile anesthetics are similar to the pharmacodynamics of propofol administration).

In a recent study with total intravenous anesthesia (TIVA) propofol/fentanyl, we found the average propofol infusion rate required to maintain hemodynamics within ±15% of baseline was 140 $\mu g \cdot kg^{-1} \cdot min^{-1}$ with a fentanyl concentration maintained at 1.5 ng/ml (by a pharmacokinetic model driven infusion system).[10] This concentration of fentanyl can be achieved by a manual infusion scheme of an initial bolus of 4 μg/kg (given over 5–15 min) followed by a continuous infusion of 1.5 $\mu g \cdot kg^{-1} \cdot h^{-1}$.

Numerous studies have been published on the use of TIVA and the advantages of this technique. With the introduction of drugs that have made TIVA feasible for routine anesthetic care and the advent of delivery systems more suited to intravenous drugs, it is likely that this technique will increase in popularity. Similar to the use of the potent volatile anesthetics, when these drugs are used, the clinician must be familiar with the pharmacokinetics, pharmacodynamics, and drug delivery system to ensure optimal anesthesia and limit any morbidity that may be associated with the technique.

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† Eger: Personal communication.