have no pain, reductions obviously cannot be achieved at all. For this reason, some investigators prefer to allow pain to develop and then investigate the pain relief associated with the intervention of interest. We think it is better for the participants if pain can be kept as low as possible in all groups, designed our study with this approach in mind, and provided a fairly detailed discussion of this point. The use of a placebo group would certainly result in increased pain within that cohort; the difference between a placebo group and a group receiving the combination of drugs evaluated in our study might well be expected to exceed the differences demonstrated with our design, but we had ethical concerns about using such a control. In our study, all participants received analgesia pro-actively, so the mean pain scores in our single agent groups were reasonably modest. Those who received the combination experienced about 30% less pain than those who received either agent alone, with time-adjusted area under the curve values for acetaminophen, ibuprofen, and combination of 33.0 and 34.8 vs 22.3 and 40.4 and 40.2 vs 28.4 mm at rest and on activity, respectively. These data are clearly and fully presented, so readers can make up their own minds about the clinical relevance of our results, but we believe that they show a worthwhile improvement to already acceptable levels of analgesia, sustained over a reasonable period of time.

A 30% reduction in modest levels of pain is no mean achievement for a combination of two established and inexpensive drugs used in doses that have an excellent safety record.

Conflict of interest
The Department of Anaesthesiology of the University of Auckland has received payment from AFT Pharmaceuticals for conducting this study, but none of the investigators has received payment in a personal capacity.

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Transcatheter aortic valve insertion: anaesthetic implications of emerging new technology

Editor—We read with great interest the comprehensive review of transcatheter aortic valve insertion (TAVI). Our hospital (St Thomas’, London, UK) is involved in this new development and since March 2008, we have conducted 110 procedures using the Edward-Sapiens valve with almost equal numbers of transfemoral and transapical cases. As there were no published data on the anaesthetic management of these very complex cases, our technique and management has evolved over the last 18 months. We wish to share some of our experiences which we feel will complement this excellent review.

Before operation, we tend to withhold aspirin and clopidogrel until after the procedure for the transapical operations. Occasionally (3%), some transfemoral procedures have had to be converted to transapical; therefore, it is useful to avoid platelet inhibition. Intraoperatively, we have found that maintenance of normothermia is paramount to early extubation. Therefore, we start active warming using forced-air warmers as soon as the patient arrives in the anaesthetic room, and this is maintained throughout the procedure. We agree that a ‘cardiac’ type, predominantly opioid-based anaesthetic, by virtue of its haemodynamic stability, is most suitable. Although a traditional high-dose fentanyl with benzodiazepine technique is well accepted, we prefer to use target-controlled remifentanil with sevoflurane and endeavour to extubate our patients ‘on table’. After induction of anaesthesia, in addition to a central venous catheter, we have found the insertion of a pulmonary artery introducer, a useful safety device. Besides providing an additional wide-bore central venous access, it also allows rapid insertion of temporary pacing wires in an event of a bradyarrhythmia or heart block in the postoperative period. It must be emphasized that these patients (including transapical cases) do not have epicardial pacing wires inserted routinely and temporary transvenous pacing wires inserted through the femoral vein are usually removed.

After insertion of the lines, external defibrillator pads must always be applied as up to 10% of the patients developed either ventricular tachycardia or ventricular fibrillation after termination of the rapid ventricular pacing which is performed during aortic balloon valvuloplasty and during valve deployment. For transfemoral procedures, the surgical incision is restricted to the groin and therefore deep anaesthesia is not required. However, transapical can...
be far more stimulating as it involves dissection in the intercostal space and occasionally rib resection. Furthermore, for transapical procedures, it is imperative to be cognizant of the fact that patients with aortic stenosis can develop very high intraventricular pressures associated with systolic hypertension. Peak intraventricular pressure is the sum of arterial (aortic) systolic pressure and the peak gradient across the aortic valve. For example, if the systolic arterial pressure is 150 mm Hg and the peak aortic valve gradient is 75 mm Hg, the peak intraventricular pressure will be 225 mm Hg. This can result in tearing of the ventricular apex with disastrous consequences. Therefore, tight arterial pressure control during placement of pledgeted sutures on the apex and during insertion of dilators and access sheath is essential. We aim to maintain the systolic arterial pressure between 90 and 100 mm Hg. Management of rapid ventricular pacing and its aftermath is also crucial in both transapical and transfemoral procedures. Pacing a ventricle with severe outflow obstruction is also crucial in both transapical and transfemoral procedures. For example, if the systolic arterial pressure is 150 mm Hg and the peak aortic valve gradient is 75 mm Hg, the peak intraventricular pressure will be 225 mm Hg. This can result in tearing of the ventricular apex with disastrous consequences. Therefore, tight arterial pressure control during placement of pledgeted sutures on the apex and during insertion of dilators and access sheath is essential. We aim to maintain the systolic arterial pressure between 90 and 100 mm Hg.

Management of rapid ventricular pacing and its aftermath is also crucial in both transapical and transfemoral procedures. Pacing a ventricle with severe outflow obstruction due to aortic stenosis at a rate of more than 200 min⁻¹ abolishes cardiac output and coronary perfusion while increasing its oxygen consumption substantially. Re-establishing adequate coronary perfusion pressure is crucial for ventricular recovery, which can be assisted by vasopressors. We tend to use either norepinephrine infusion or boluses of metaraminol. Patients with poor ventricular function (Ejection Fraction <35%) are routinely given a dobutamine infusion in the intraoperative period.

After operation, majority of patients undergoing transfemoral procedures can be extubated in the catheter laboratory. Analgesic requirements are minimal and routine wound infiltration with local anaesthetic and i.v. acetaminophen before extubation provides satisfactory analgesia. However, with transapical procedures, provision of good postoperative analgesia is crucial if ‘on-table’ extubation is to be attempted. Regional anaesthetic techniques, such as continuous intercostal nerve block, thoracic paravertebral block, and thoracic epidural block, provide an attractive option thereby avoiding the excessive use of systemic opioids and resulting sedation and cognitive impairment. An intercostal block through a catheter placed by the surgeon in the neurovascular plane of the intercostal space during chest closure is probably the easiest option. Unfortunately, in our experience, satisfactory analgesia with this technique alone is seldom achieved. The catheter should be directed as far posterior as possible, ideally close to the angle of the ribs, but this is not practical with an anterior intercostal incision.

Continuous thoracic paravertebral block (under X-ray or ultrasound guidance both of which are readily available in the catheter laboratory) through an indwelling catheter in left paravertebral space is an attractive alternative, and requires less intense monitoring when compared with the continuous thoracic epidural block when the patient is discharged from the high dependency unit. Unfortunately, the failure rate has been relatively high (up to 50%), reflecting a need to gain more experience with this technique. Unlike intercostal and paravertebral techniques, timing of catheter removal is crucial. It should be removed at least 2–4 h before commencing oral clopidogrel. After operation, these patients are closely monitored in a level 2 facility. We have successfully used lumbar epidural anaesthesia with light sedation in three patients undergoing transfemoral procedures who had severely impaired respiratory function. These patients were quite slim; therefore, transthoracic echocardiography could be used satisfactorily in place of transoesophageal echocardiography.

Finally, in the event of major complications, provision must be made to rapidly establish femoral arteriovenous bypass. We feel that the cardiopulmonary bypass (CPB) circuit should be primed and ready, and all the appropriate equipment (cannulae, dilators and connectors, sternotomy kit, etc.) should be ready. In our institution, of the first 100 cases, we have so far had to support two patients with femoro-femoral CPB for radically different reasons (intractable ventricular fibrillation, tear of the left ventricle) and outcomes (death, full recovery). In the second case, application of lessons learned from the first patient regarding a delay in initiating CPB due to equipment mismatch was beneficial.

To conclude, it is our view that the anaesthetic management of this high-risk group of patients will continue to evolve as we gain more experience with this novel and innovative technique.

Conflicts of Interest

None declared.

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Opioid-induced hyperalgesia: low-dose ketamine does work for some orthopaedic problems already

Editor—I read with interest the original article and accompanying editorial on opioid-induced hyperalgesia (OIH).12 There are already clinical studies, which support some of the findings, although the type of pain may be slightly