an increased incidence of PDPH for both groups suggesting that placing the intrathecal catheter after unintentional dural puncture may be responsible, but they do not provide information about the type and size of the catheter.

The impact of intrathecal morphine and diamorphine on developing PDPH was evaluated in a long-term, retrospective audit by Martlew.[177] The author suggested a reduced incidence of PDPH following a change from fentanyl (0.88%) to diamorphine (0.49%), with other elements of spinal anesthesia remaining the same (eg, needle type). However, no information was provided about how PDPH was diagnosed or the incidence of side effects from intrathecal opioids.

Hydroxyethyl starch solutions (HES), dexamethasone and saline, given via the epidural or spinal route, have been evaluated as prophylactic agents for PDPH following inadvertent dural puncture. Najafi *et al* injected dexamethasone 8 mg (in 2 mL of saline) or 2 mL saline after uneventful spinal anesthesia without noting any beneficial effect in reducing the incidence of PDPH.[178] In a retrospective case series, Song *et al* assessed the effectiveness of injecting HES 6% solution 15 mL into the epidural space to prevent PDPH after an inadvertent dural puncture.[179] The authors concluded that this was highly effective in preventing the occurrence of PDPH. However, a limitation was that the injection of HES was performed 24 hours after using an epidural catheter to provide analgesia; therefore, it is unclear which intervention was effective.

In a randomized trial of 100 women, Faridi Tazeh-Kand *et al* investigated the effect of intrathecal saline 5 mL injected before hyperbaric bupivacaine compared with hyperbaric bupivacaine alone, for spinal anesthesia for elective cesarean section.[180] The incidence and severity of PDPH were assessed after 48 hours and again 3–7 days postoperatively. The incidence of moderate and severe PDPH during the first postoperative 48 hours was no different between groups. However, the frequency of PDPH after 3–7 days was significantly higher in the bupivacaine-alone group compared with the saline/bupivacaine group (16% vs 2%, p=0.03). No information on other effects of the addition of saline, such as block extension or duration of anesthesia, was reported.

In an observational study, three consecutive groups of 50 obstetric patients received spinal anesthesia. The control group received no prophylactic treatment for PDPH, the second group received an epidural saline injection of 20–25 mL and the third group received an abdominal binder. There was no statistically significant difference between the two intervention groups (6% vs 4%), but results showed that applying either intervention could significantly reduce the incidence of PDPH.[170] However, the study was small and did not describe the use of abdominal binders to ensure reproducibility. Additionally, the technique of injecting epidural saline after spinal injection (while retracting the spinal needle) was questionable and likely to produce variable results.

- **Recommendation**: *Routine injection of any substance intrathecally or epidurally to prevent PDPH is not recommended (Grade I; Low Level of Certainty).*

Pharmacological measures

Several authors have studied the effect of paracetamol, caffeine, morphine, dexamethasone and aminophylline in preventing PDPH following uneventful spinal anesthesia and reported no benefit.[181–184] Hakim evaluated the effect of intravenous cosyntropin in an RCT and noted a significant benefit in preventing PDPH.[185] Following inadvertent dural puncture with either a 16G or 18G epidural needle, 90 obstetric patients were randomly assigned to receive cosyntropin 1 mg intravenously or an equal volume of normal saline. There was a significant difference in the proportion of patients who developed PDPH in the cosyntropin group, 15/45 (33%) compared with 31/45 (68.9%) in the control group (p=0.001). Significantly fewer patients in the cosyntropin group required an EBP compared with the control group (5 (11.1%) vs 13 (28.9%), p=0.035).

In an RCT, Vahabi *et al* compared the effect of regular gabapentin versus placebo in 120 patients after spinal anesthesia and found a reduction in headache incidence and severity, and morphine consumption.[186] However, the nature of headaches in all patients was unclear. There were no differences between groups in the incidence of adverse side effects.

Okpala *et al* reported a reduction in PDPH with preoperative intravenous dexamethasone 8 mg compared with placebo following uneventful spinal anesthesia for cesarean section.[187] However, this finding contradicts those from a meta-analysis (four RCTs)[183] and an RCT in cesarean section patients,[188] which indicated that dexamethasone does not produce a statistically significant effect and may in fact aggravate the severity of PDPH. The meta-analysis has several methodological heterogeneities, such as limited sample size, duration of follow-up and needle size variations, all of which make any strong inferences difficult.

- **Recommendation**: *There is insufficient evidence to recommend routine systemic drug administration for PDPH prophylaxis (Grade I; Low Level of Certainty).*

Question 5: what conservative measures may be used to treat PDPH?

Non-pharmacological measures

Bed rest

There are no published RCTs examining the effect of bed rest in the treatment of PDPH. Some temporary relief of headache is often obtained, but prolonged bed rest is undesirable because of the risks associated with immobilization.

- **Recommendation**: *Evidence does not support routine use of bed rest to treat PDPH, but it may be used as a temporizing measure for symptomatic relief (Grade C; Low Level of Certainty).*

Fluid therapy

Increased oral intake of fluids is often encouraged, or intravenous fluid therapy is started to maintain or increase CSF production in patients with PDPH. While a single clinical trial noted no benefit of fluid therapy for prophylaxis,[189] no other studies have evaluated the benefit of either oral or intravenous fluid therapy exclusively for treating PDPH. Dehydration could worsen CSF production and headache.

- **Recommendation**: *Adequate hydration should be maintained with oral fluids; intravenous fluid should be used when oral hydration cannot be maintained (Grade C; Low Level of Certainty).*

Abdominal binders

Abdominal binders are thought to work by increasing pressure within the spinal canal, pushing CSF cephalad, thereby reducing headache. There are few data to support the use of abdominal binders for either prophylaxis or treatment of PDPH, with only one study showing benefit.[170] Abdominal binders are likely impracticable after recent abdominal or truncal surgery and unacceptable to patients.