12.3.5.4 Fentanyl

Fentanyl patches were randomly assigned to subjects for placement on the upper outer arm, back, and chest. When compared to absorption at the upper arm, absorption was 29% lower from the upper chest site and 10% lower for the upper back site (Table 12.7). When the application was repeated at the same sites, there were decreased differences in absorption between all three sites (32).

Solassol and colleagues (33) found no significant differences in estimated percutaneous absorption due to fentanyl patch placement at the arm, shoulder, chest, and back. Absorption was estimated by measuring remaining fentanyl in patches after use.

12.3.5.5 Hormonal Contraceptives

A contraceptive patch containing ethinyl estradiol and gestodene was tested at three location sites: upper outer arm, buttocks, and abdomen. There was no significant difference in percutaneous absorption at any of the sites (Table 12.8) (34). Stanczyk and colleagues (36) found less absorption at the abdomen compared to the back and buttocks of a low-dose ethinyl estradiol patch (Table 12.8). However, therapeutically, all three patch application sites were similar. Abrams and colleagues (22) collected absorption data on a patch containing ethinyl estradiol and norelgestromin also showing decreased absorption of both hormones, yet still within the therapeutic range (Table 12.8). Yet another study regarding 17-B-estradiol absorption showed 88% of the $AUC_{0\text{-last}}$ for an abdominal patch location compared to the buttock (Table 12.8) (37).

12.3.5.6 Nicotine

Nicotine patches were applied to the upper arm, abdomen, and back and percutaneous absorption by Sobue and colleagues (38); they found no significant difference in absorption between the upper arm and back. However, there was significantly less absorption between the upper arm and abdomen (AUC ratio of upper arm to abdomen was 75%) (Table 12.7).

12.3.5.7 Methylphenidate

In two clinical trials, methylphenidate patches were tested for differences in percutaneous absorption (39, 40). The first performed in children showed decreased bioavailability of methylphenidate when applied to the scapula compared to the hip (Table 12.7) (39). The second showed 2.9 times more permeability of methylphenidate when applied to the oral buccal mucosa compared to the arm (Table 12.7) (40).

12.3.5.8 Oxybutynin

Patches were applied for 96 hours in 24 healthy volunteers in a study determining pharmacokinetics of oxybutynin. The abdomen, buttocks, and hip proved bioequivalent (Table 12.8) (41).

12.3.5.9 Rivastigmine

Lefevre and colleagues (24) applied rivastigmine patches to the upper back, chest, upper arm, abdomen, and thigh. Greater adhesive properties of the patch at the thigh and abdomen were found; however, these locations offered less-than-optimal bioavailability compared to the patches placed on the upper back, chest, and upper arm (Table 12.7) (24).

12.3.5.10 Rotigotine

In work performed by Elshoff and colleagues (25), three open-label, randomized, phase 1 multiple-dose studies were pooled and bioavailability of the medication at the shoulder, upper arm, abdomen, flank, hip, and thigh calculated. There were differences in bioavailability; however, there was no significance on outcomes of clinical efficacy (Table 12.7) (25).