Psychopharmacology and adverse effects of antipsychotic long-acting injections: a review

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Background
Depot antipsychotics are widely used in clinical practice. Long-acting formulations of second-generation antipsychotics are now being developed and introduced.

Aims
To review the pharmacology, pharmacokinetics and adverse effect profiles of currently available antipsychotic long-acting injections (LAIs).

Method
The psychopharmacological properties of first- and second-generation antipsychotic LAIs are reviewed using data available up to October 2008.

Results
First-generation antipsychotic (FGA) LAIs are associated with a high rate of acute and chronic movement disorders. Risperidone LAI is better tolerated in this respect, but is associated with hyperprolactinaemia and weight gain. Olanzapine LAI causes weight gain and other metabolic effects but appears not to be associated with an important incidence of movement disorders.

Conclusions
Dosing of LAIs is complicated by delayed release of drug, changes in plasma levels without change in dose, and by the lack of data establishing clear dose requirements. All LAIs offer the prospect of assured adherence (although patients may still default on treatment) but their use is complicated by adverse effects, complex pharmacokinetics and confusion over dose-response relationships.

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There are currently eight antipsychotic long-acting injections (LAIs) in widespread use around the world. Six of these are LAI preparations of first-generation antipsychotics (FGAs), including flupentixol, fluphenazine, haloperidol, perphenazine, pipotiazine and zuclopenthixol, and the remaining two are LAI formulations of the second-generation antipsychotics (SGAs) risperidone and olanzapine. The dosing characteristics of these LAIs are summarised in Table 1.

Pharmacokinetic characteristics
Almost all antipsychotics have short plasma half-lives of 1–2 days at most. This means that antipsychotics have to be administered frequently in order to attain and maintain therapeutic effects. Although the elimination half-lives of these drugs cannot be altered to any important degree, chemical manipulation of the parent compound and changes in pharmaceutical formulation can significantly alter drug release or absorption characteristics. When absorption and/or release are extensively prolonged, effective plasma half-life can be extended (half-life is dependent on release rather than elimination).

Some FGAs possess a terminal alcohol (–OH) group which allows them to be combined with carboxylic acids by a process of esterification. Long-chain esters show high oil solubility and low water solubility. Long-acting injectable formulations of FGAs contain long-chain drug esters (e.g. decanoate, palmitate) dissolved in a vegetable oil. When injected intramuscularly, the oil forms a depot of drug: the drug ester slowly diffuses into the bloodstream and is then rapidly hydrolysed to release the parent drug.1 Most SGAs lack terminal –OH groups suitable for esterification. Modification of release characteristics is brought about by other means: encapsulating the drug into a biodegradable polymer (risperidone) or injecting a suspension (i.e. water-insoluble particulate matter in water) of drug compound (olanzapine pamoate).

First-generation LAIs

Flupentixol
Flupentixol is a thioxanthine antipsychotic. Flupentixol LAI is formulated as flupentixol decanoate in a low-viscosity vegetable oil (fractionated coconut oil). Flupentixol decanoate provides peak plasma levels 3–7 days after intramuscular injection and shows an apparent half-life of 17 days.2,3 Steady-state plasma levels can be expected to be achieved after 2 months or so of regular dosing. In practice, plasma levels may show marked variability independent of dose changes.4

Fluphenazine
Fluphenazine is a piperazine phenothiazine compound. Fluphenazine decanoate is available as an LAI in sesame oil. Plasma levels peak within 24 h of intramuscular injection,5 and the half-life is approximately 7–14 days.5,6 Plasma levels obtained vary up to 40-fold in patients receiving the same dose.5 Smoking significantly reduces plasma fluphenazine levels.7

Haloperidol
Haloperidol is a butyrophenone and is available as haloperidol decanoate in sesame oil. Peak plasma levels are seen up to 7 days after intramuscular injection and plasma half-life is around 3 weeks.1,7 Steady-state plasma levels can be expected to be reached after 2–3 months of regular dosing.8 As with fluphenazine, clearance of haloperidol is significantly increased by smoking.9 Nonetheless, variation in plasma levels is smaller in patients receiving haloperidol decanoate than in those receiving oral haloperidol.10

Perphenazine
Perphenazine is a piperazine phenothiazine available as perphenazine decanoate in sesame oil, used mainly in northern Europe.
and Scandinavia. After intramuscular injection, peak plasma levels are obtained in 1–7 days and the half-life is approximately 2 weeks. Variations in plasma levels during regular dosing are small, and plasma levels are directly correlated with dose.

### Second-generation antipsychotics

**Olanzapine pamoate**
- Licensed dosing intervals: 2–4 weeks
- Licensed dosing intervals (UK): 2–3 months
- Test dose: 20 mg
- Typical clinical dose per 2 weeks: 60 mg
- Dose per dose: Not recommended

**Risperidone microspheres**
- Licensed dosing intervals: 2–4 weeks
- Licensed dosing intervals (UK): 2–3 months
- Test dose: 37.5 mg
- Typical clinical dose per 2 weeks: 225 mg
- Dose per dose: Not appropriate

### Dose and administration

As with oral antipsychotics, dosing requirements for LAIs in individuals vary enormously. Examination of population data (as below) can provide some guidance on optimum dosing, but individual variation should always be borne in mind and dose adjustments should be according to patient response and tolerability.

Flupentixol decanoate is given initially as a test dose of 20 mg. After 7 days a further dose of 20–40 mg is given. Dosing is then at intervals of 2–4 weeks, at doses ranging from 50 mg every 4 weeks to 400 mg weekly. Dose–response relationships are less than clear. One study showed 40 mg every 2 weeks to be as effective in improving ‘ward behaviour’ and better tolerated than 200 mg every 2 weeks in female patients over 13 weeks’ treatment. In the other study a 50% dose reduction to 6 mg per week led to substantially increased risk of relapse compared with participants not undergoing dose reduction receiving on average 9 mg per week. In contrast, another study in patients stabilised on higher doses showed that reducing the dose of flupentixol below 200 mg every 2 weeks significantly increased the risk of relapse. This study was also a double-blind randomised trial but included only 18 participants.

Fluphenazine decanoate is initiated with a test dose of 12.5 mg. Maintenance doses are in the range 12.5–100 mg given every 2–5 weeks – the maximum dose is thus 100 mg every 2 weeks. Much lower doses appear to be effective – 25 mg every 2 weeks is no more effective than 25 mg every 6 weeks. There is some support for even lower doses, but controlled trials suggest that doses substantially less than 25 mg every 2 weeks greatly increase the risk of relapse.
For haloperidol decanoate no formal test dose is specified. Treatment is usually begun with a dose of 50 mg and maintenance doses are usually in the range 50–300 mg every 4 weeks (in the USA up to 20 times the previous oral haloperidol dose can be used). Doses of around 100 mg every 4 weeks are probably optimal.31,32 Relapse prevention is not improved by higher doses. A dose of 25 mg every 4 weeks is probably ineffective,31 whereas doses of around 50 mg every 4 weeks may be effective in some patients.31,33

Perphenazine plasma levels of 1–5 nmol/l have been associated with good therapeutic response,34 although a higher therapeutic range has been suggested.35 In a study that aimed to discover the minimum effective dose of perphenazine decanoate, it was found that this was around 100 mg every 2 weeks (range 21.6–270.5 mg every 2 weeks).13 Plasma levels ranged from around 2 nmol/l to 18 nmol/l depending on dose. In a further study of responding patients receiving 108.5 mg perphenazine decanoate every 2 weeks, plasma levels averaged 5 nmol/l and ranged from around 2 nmol/l to 6 nmol/l.11 Other studies have shown that doses of around 100 mg every 2 weeks are effective and provide plasma levels in the range 3–11 nmol/l.36,57

Pipotiazine palmitate is usually first given as a test dose of 25 mg. Maintenance doses are usually within the range 50–200 mg every month (up to 250 mg in Canada). The dose–response relationship is poorly defined. An early study suggested that the optimal dose of pipotiazine palmitate was between 100 mg and 600 mg every 4 weeks.38 Later trials found doses of 50–200 mg every 4 weeks to be adequately effective.39,40

Zuclopenthixol decanoate is initiated with a test dose of 100 mg and maintenance doses vary from 200 mg every 4 weeks to 600 mg a week. In an open dose-reduction study of 23 patients, the minimum effective dose was shown to be, on average, 200 mg every 2 weeks (range 60–400 mg).41 In practice zuclopenthixol is often given at weekly or 2-weekly intervals. However, doses of 100–600 mg (mean 284 mg) given every month showed that peak D2 occupancies were in the range 66–82% a week after injection.51 In an extension of this study (n=8, including two patients who participated in the previous study), D2 occupancies peaked at 60–82% a week after injection (doses 30–50 mg every 4 weeks).54 Four weeks later occupancies were in the range 20–74%. The patients remained well despite these low occupancies.

A relatively recent study of patients responding to perphenazine decanoate found that at plasma levels of 1.8–9 nmol/l striatal D2 occupancy ranged from 66% to 82%.55 Doses used were in the range 38–108 mg per 2 weeks.

One study has examined D2 occupancy produced by olanzapine pamoate.56 Participants were switched from oral olanzapine to the LAI (300 mg every 4 weeks) and followed up for 6 months. Olanzapine D2 receptor occupancy averaged 69% for oral olanzapine (5–20 mg per day) but then fell to around 55% in the first month before rising to just over 60% (all trough samples). There was no change in patients’ clinical condition over the study period.

Two studies have determined D2 occupancy associated with the use of risperidone LAI. In the first, 28 patients received 2-weekly injections of 25 mg, 50 mg or 75 mg risperidone and D2 occupancy was estimated 2 weeks after the fifth injection (i.e. at steady-state trough plasma levels): the D2 occupancies were 25–48% for 25 mg, 59–83% for 50 mg and 62–72% for 75 mg.22 In the second study D2 occupancies were determined for nine participants up to 3 days after injection and less than 5 days before the next injection.57 All participants had at least five injections before PET determinations were carried out. Occupancies were 53–75% for two patients receiving 25 mg, 59–85% for five patients receiving 50 mg and 71–85% for two patients receiving 75 mg.

Data on D2 occupancies associated with the use of LAIs are somewhat perplexing. They appear to show apparently sub-therapeutic D2 occupancies associated with some doses, at least at some time points, without attendant relapse. This may mean that persistently high striatal D2 receptor occupancy is not required for full therapeutic effect, or that other D2 activity outside the striatum or other receptor activities are relevant. On the other hand, the low occupancies seen with low doses of haloperidol and risperidone do fit with clinical data which suggest that these doses are suboptimal.31,33,48,49

Pharmacodynamics

Both first-generation and second-generation antipsychotics administered by any route are presumed to exert their antipsychotic action by blocking central dopamine receptors of the D2 receptor subtype. All LAIs are potent in vitro antagonists of D2 receptors. In vivo, potency in humans is usually determined by measuring striatal D2 occupancy using methods such as positron emission tomography (PET) and single photon emission computerised tomography (SPECT). Therapeutic response seems to be associated with striatal D2 occupancies of 65% or greater, whereas hyperprolactinaemia and extrapyramidal side-effects occur at occupancies of 72% and 78% respectively,56 although these observations are based on a single study including a limited number of individuals. Antipsychotic action may not be derived from activity in the striatum, but striatal occupancies correlate closely with response to antipsychotic treatment.51

Few studies have examined striatal D2 occupancy afforded by the use of LAIs. The earliest PET study found occupancies of 50–80% for patients receiving haloperidol decanoate 50–200 mg a month, pipotiazine palmitate 100 mg a month and fluphenazine decanoate 200 mg a month.52 Occupancy levels appeared to increase in the 20 days following injection. A later study of four patients receiving 30–50 mg haloperidol decanoate a month showed that peak D2 occupancies were in the range 66–82% a week after injection.51

Adverse effects

Long-acting injection formulations of FGAs might be expected to give rise to acute extrapyramidal symptoms, tardive dyskinesia...
and symptoms related to hyperprolactinaemia. The frequency of movement disorders and tardive dyskinesia with FGAs/LAIs is similar to that seen with oral FGAs. Consequently the clinical utility of the LAIs is often seen to be severely limited by the likelihood of these important adverse effects (Appendix 1).

Flupentixol decanoate typically causes extrapyramidal symptoms, sedation and dry mouth. In one study of patients receiving 40 mg every 3 weeks, 97% showed signs of extrapyramidal symptoms and 82% received anti-Parkinsonian medication. Fluphenazine decanoate (25 mg every 3 weeks) in the same trial caused extrapyramidal symptoms in 97% of patients and 93% required anti-Parkinsonian medication. Rates of other important side-effects such as incident depression were virtually identical for flupentixol and fluphenazine (53% v. 55%). Fluphenazine decanoate is also associated with blurred vision and excess salivation. Weight gain of more than 1 kg is common. Changes in prolactin levels seem to be dose-related.

Haloperidol decanoate is also associated with a dose-dependent rise in plasma prolactin and in one study caused extrapyramidal symptoms severe enough to warrant anti-Parkinsonian drugs in around 90% of patients (dose averaging around 250 mg every 2–4 weeks). Although haloperidol decanoate is often assumed to give the highest risk of extrapyramidal symptoms, this has not been demonstrated in comparative studies. Changes in prolactin levels seem to be dose-related.

Perphenazine decanoate, like other first-generation drugs, is associated with acute extrapyramidal symptoms. Reported prevalences of such symptoms or use of anticholinergic drugs range from 29% to 55%. Other studies suggest high rates of extrapyramidal symptoms and hyperprolactinaemia with perphenazine enanthate, but this ester of perphenazine is known to result in much higher plasma levels of perphenazine than perphenazine decanoate. The total number of patients examined in well-conducted trials with either ester appears to be only 313. Injection site abscesses have been reported for perphenazine enanthate. Weight gain seems not to occur with perphenazine decanoate.

Pipotiazine palmitate (mean dose 65 mg per month) has been shown to cause similar rates of extrapyramidal symptoms as haloperidol decanoate (mean dose 100 mg per month): 36% and 29% respectively. In the same study weight gain of more than 5 kg was more common in those receiving pipotiazine (39% v. 16%). As a piperidine phenothiazine, pipotiazine might be expected to show a low incidence of extrapyramidal symptoms. There is limited evidence that pipotiazine has a relatively low potential for causing these symptoms compared with other LAIs.

Zuclopenthixol typically causes extrapyramidal symptoms and mild autonomic effects such as postural dizziness and blurred vision. In one study of doses ranging from 50 mg to 300 mg every 2 weeks, 61% of participants experienced extrapyramidal symptoms and 78% required anti-Parkinsonian medication. A meta-analysis of comparative trials of FGA–LAIs doses revealed no differences in the rates of extrapyramidal symptoms and tardive dyskinesia compared with oral medication and few important differences between individual LAIs. Other sources suggest an increased incidence of extrapyramidal symptoms and tardive dyskinesia with LAIs compared with oral antipsychotics. Both reviews reported an increased risk of movement disorders with fluphenazine decanoate compared with other FGA–LAIs.

Adverse effects seen with olanzapine pamoate are similar to those seen with oral olanzapine. Common side-effects include increased plasma triglycerides, weight gain, sedation and increased appetite. Extrapyramidal symptoms have not been reported more frequently than with oral olanzapine and the incidence of tardive dyskinesia is not known.

Solubility experiments have revealed that when olanzapine pamoate LAI is injected into the muscle as intended, the dissolution of the salt is gradual and results in a slow release of drug into the blood stream. However, if the salt comes into contact with a considerable amount of blood or plasma, as occurs if the needle punctures a vessel or enters a rich capillary bed during administration, the salt dissolves and therefore dissociates more quickly. Other factors thought to affect the dissolution rate of the pamoate salt are the volume and rate of blood flow and the degree of vascular injury.

The patient should be advised about the potential risk of post-injection syndrome and needs to be observed for 3 h in a healthcare facility each time that the injection is administered. Prior to giving the injection the clinician should determine that the patient will not have to travel alone to his or her next destination. The patient should be advised to be vigilant for signs and symptoms of overdose. If post-injection syndrome is suspected, close medical supervision and monitoring should continue until examination indicates that signs and symptoms have resolved.

For the remainder of the day after injection, patients should be advised to travel alone to their next destination. Giving the injection the clinician should determine that the patient is alert and oriented and that there is no sign or symptom of overdose. If post-injection syndrome is suspected, close medical supervision and monitoring should continue until examination indicates that signs and symptoms have resolved.

**Fig. 1** Olanzapine plasma concentration profiles for a period during which six injections were administered to a patient who experienced an inadvertent intravascular (IAV) event after the second injection.
The use of LAIs is confined to those who have already received antipsychotic medication: these injections should never be given to antipsychotic-naïve patients. Treatment with LAIs is therefore initiated in those already taking antipsychotics or those who, for whatever reason, have recently stopped taking them. Initiation of LAIs is complicated by a number of factors (Appendix 2). First-generation antipsychotic LAIs are usually first given as a test dose, or at least at a dose at the lower end of the licensed range. These test doses are aimed at establishing patient tolerability of the drug and vehicle administered. However, test doses given in this way only really establish or otherwise the tolerability of a single, small dose of the LAI. Their use has little bearing on likely tolerability in multiple, higher-dose treatment because plasma levels at steady state are considerably higher than after a single dose. For example, in one study in which patients were given fluphenazine decanoate 50 mg every week, plasma levels quadrupled between the end of the first week and the end of the sixth week. This substantial rise in plasma levels despite there being no change in dose is likely to be seen with all LAIs because of their shared long plasma half-lives, and makes sensible dose titration almost impossible. An added difficulty here is that population dose–response relationships are poorly defined for most LAIs (olanzapine, risperidone and haloperidol are the exceptions). In practice, therefore, dose optimisation is a matter largely of conjecture, and patient tolerability is often used as a proxy for dose limitation. Furthermore, the use of oral antipsychotics as ‘cover’ during the early stages of LAI treatment often leads to prolonged polypharmacy (there is evidence that prescribers tend not to change regimens once patients improve, presumably because to do so would be to risk relapse).}

### Appendix 1

#### Adverse effects

**Extrapyramidal symptoms**

Symptoms are tremor, rigidity, mask-like face, reduced arm swing, drooling, dystonia (muscular spasm), oculogyric crisis, akathisia (severe inner restlessness).

**Tardive dyskinesia**

Tardive dyskinesia is characterised by:

- abnormal masticatory movements (lip-smacking, licking);
- tongue protrusion;
- vermicular (worm-like) movement;
- abnormal postures (tardive dystonia): opisthotonos (arching of back and neck), retrocollis (backward arching of head and neck), torticollis (sideways turn of head and neck);
- digital abnormalities (‘pill-rolling’, ‘piano playing’, ‘guitar playing’);
- grimacing.

**Metabolic adverse effects**

Effects include impaired glucose tolerance/diabetes mellitus, weight gain, increased triglyceride levels, increased cholesterol levels.

### Appendix 2

#### Factors complicating long-acting injection dosing

(a) The effect of any dose is likely to be prolonged. Test doses are usually required but may not properly assess tolerability in longer-term use.

(b) Some long-acting injections (LAIs) show delayed as well as prolonged release. Cover with oral antipsychotics may be necessary.
Attainment of steady-state plasma levels is usually delayed for up to 2–3 months. During this time, plasma levels are likely to rise substantially even when dosages are not increased.

Dose-response relationships are poorly defined for most LAIs.

References

58 Haddad PM, Taylor M, Niaz, OS. First-generation antipsychotic long-acting
62 Nyberg S, Farde L, Halldin C, Dahl ML, Bertilsson L. D2 dopamine
64 Nyberg S, Farde L, Halldin C. Delayed normalization of central D2 dopamine
66 Kane JM, Eerdekeens M, Lindenmayer JP, Keith SJ, Lesem M, Karcher K.
67 Chouinard G, Annable L, Campbell W. A randomized clinical trial of
68 Eberhard G, Hellbom E. Haloperidol decanoate and flupenthixol decanoate
69 Wistedt B, Persson T, Hellborn E. A clinical double-blind comparison between
70 Wistedt B. A comparative trial of haloperidol decanoate and fluphenazine
decanoate in chronic schizophrenic patients. Int Clin Psychopharmacol 1986;
71 Lindholm H, Gullberg B, Ohman A, Sedval G. Effects of perphenazine
enanthate injections on prolactin levels in plasma from schizophrenic women
72 Ahltors UG, Dencker SJ, Gravem A, Remvig I. Clopenthixol decanoate
and perphenazine enanthate in schizophrenic patients. A double-blind Nordic
Perphenazine decanoate vs. perphenazine enanthate: efficacy and side
effects in a 6 week double-blind, comparative study of 50 drug monitored
74 David A, Quraishi S, Rathbone J. Depot perphenazine decanoate and
enanthate for schizophrenia. Cochrane Database Syst Rev 2005; (3):
CD001717.
75 Starmark JE, Forsman A, Wahstrom. Abscesses following prolonged
intramuscular administration of perphenazine enanthate. Acta Psychiatr
76 Hay J. Complications at site of injection of depot neuroleptics. BMJ 1995;
311: 421.
77 McDonnell D, Sorsaburu S, Brunner E, Detke H, Anderson S, Bergstrom R,
et al. Post-injection delirium/sedation syndrome observed with olanzapine
long-acting injection: review of the first 25 events. Eur
78 Eli Lilly. Summary of Product Characteristics. Zypladra 210 mg, 300 mg,
and 405 mg, powder and solvent for prolonged release suspension for
administration. Lilly, 2009 (http://www.fda.gov/ohrms/dockets/ac/08/briefing/
2008-4338b1-03-Lilly.pdf).
79 Schmauss M, Sacchetti E, Kahn JP, Medori R. Efficacy and safety of
risperidone long-acting injectable in stable psychotic patients previously
80 Adams CE, Fenton MKP, Quraishi S, David AS. Systematic meta-review
of depot antipsychotic drugs for people with schizophrenia. Br J Psychiatry
81 Eberhard G, Hellborn E. Haloperidol decanoate and flupenthixol decanoate
in schizophrenia. A long-term double-blind cross-over comparison. Acta
Perphenazine decanoate vs. perphenazine enanthate: efficacy and side
effects in a 6 week double-blind, comparative study of 50 drug monitored
83 Gharabawi GM, Bossie CA, Zhu Y, Mao L, Lasser RA. An assessment of
the pharmacy and adverse effects to Zyprexa Olanzapine Pamoate (OP) Depot.
Olanzapine Long-Acting Injection. CD001717.
84 Liebman JA, McEvoy JP, Swartz MS, Rosenheck RA, Perkins DO, Keefe RS,
et al. Effectiveness of antipsychotic drugs in patients with chronic
Randomized controlled trial of the effect on Quality of life of second- vs
first-generation antipsychotic drugs in schizophrenia: Cost Utility of the
Latest Antipsychotic Drugs in Schizophrenia Study (CUtLASS 1). Arch Gen

46 Kane JM, Eerdekeens M, Lindenmayer JP, Keith SJ, Lesem M, Karcher K.
Long-acting injectable risperidone: efficacy and safety of the first long-acting
olanzapine tablets for schizophrenia or schizoaffective disorder: randomised,
48 Taylor DM, Young C, Patel MX. Prospective 6-month follow-up of patients
prescribed risperidone long-acting injection: factors predicting favourable
49 Bai YM, Ting CT, Chen JY, Chang WH, Wu B, Hung CH, et al. Equivalent
switching dose from oral risperidone to risperidone long-acting injection: a 48-week randomized, prospective, single-blind pharmacokinetic study.
dopamine D2 occupancy, clinical response, and side effects: a double-blind
Striatal vs. extrastriatal dopamine D2 receptors in antipsychotic response.
A double-blind PET study in schizophrenia. Neuropsychopharmacology 2006;
Striatal dopamine receptor occupancy during and following withdrawal from
neuroleptic treatment: correlative evaluation by positron emission tomography
53 Nyberg S, Farde L, Halldin C. Delayed normalization of central D2 dopamine
receptor availability after discontinuation of haloperidol decanoate.
Preliminary findings. Arch Gen Psychiatry 1997; 54: 953–8.
54 Nyberg S, Farde L, Halldin C, Dahl ML, Bertilsson L. D2 dopamine
receptor occupancy during low-dose treatment with haloperidol decanoate.
A cross-validation study on the relationship between central D2 receptor
occupancy and serum perphenazine concentration. Psychopharmacology
(Berl) 2004; 175: 148–53.
D2 receptor occupancy of olanzapine pamoate depot using positron emission
tomography: an open-label study in patients with schizophrenia.
Neuropsychopharmacology 2008; 33: 298–304.
A PET study evaluating dopamine D2 receptor occupancy for long-acting
58 Haddad PM, Taylor M, Niaz, OS. First-generation antipsychotic long-acting
injections v. oral antipsychotic medication in schizophrenia: systematic
review of randomised controlled trials and observational studies.
59 Adams CE, Fenton MKP, Quraishi S, David AS. Systematic meta-review
of depot antipsychotic drugs for people with schizophrenia. Br J Psychiatry
60 Eberhard G, Hellborn E. Haloperidol decanoate and flupenthixol decanoate
in schizophrenia. A long-term double-blind cross-over comparison. Acta
61 Knights A, Okasha MS, Salih MA, Hirsch SR. Depressive and extrapyramidal
symptoms and clinical effects: a trial of fluphenazine versus fluphenoxil
in maintenance of schizophrenic out-patients. Br J Psychiatry 1979; 135:
215–23.
62 Johnson DAW. The side-effects of fluphenazine decanoate. Br J Psychiatry
63 Chouinard G, Annable L, Campbell W. A randomized clinical trial of
haloperidol decanoate and fluphenazine decanoate in the outpatient treatment
64 Bechelli LPC, lecco MC, Acoll A, Pontes MC. A double-blind trial of
haloperidol decanoate and pethazine palmurate in the maintenance
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References
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