A comparison, at the cellular and subcellular levels, of the effects of tamoxifen and oestradiol benzoate on the immature rat uterus

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Tamoxifen by the uterine weight test has been found to be a partial oestrogen agonist in the immature rat (Harper & Walpole, 1967), to bind to the cytoplasmic oestrogen receptor (Jordan & Prestwich, 1977) and to translocate to the nucleus in a manner analogous to that which occurs with 17β-oestradiol (Jordan, Dix, Rowsby & Prestwich, 1977).

The effects of doses of tamoxifen (25 μg in saline, s.c.) and oestradiol benzoate (25 μg in saline s.c.) which cause a prolonged depletion of the cytoplasmic oestrogen receptor pool have now been compared in groups of 12 immature female Wistar rats, each group being sacrificed 8, 12, 24 or 72 h later. Control rats were sacrificed 8 or 72 h after saline. The maximum uterotrophic response (48 h) due to tamoxifen was approximately 60% of that produced by oestradiol benzoate whereas the increase in uterine DNA content was relatively much smaller.

In a second experiment groups of 5 immature female Wistar rats were treated similarly except that 7 h prior to sacrifice colchicine (100 μg s.c.) was administered. Histological sections of the excised uteri were prepared for mitotic count and endometrial thickness determinations. Few mitoses were seen in the endometria of control animals and only very low counts occurred in tamoxifen treated animals (max. 0.68 ± 0.13 mitoses per field, $n = 50$, at 48 h). Maximum mitotic activity with oestradiol benzoate occurred at 48 h (6.26 ± 0.42 mitoses per field, $n = 50$).

By contrast with the mitotic counts, maximum endometrial thickness was observed in tamoxifen treated animals at 72 h (58.41 ± 2.14 μ, $n = 41$) and was significantly greater than that in oestradiol benzoate treated animals at both 48 and 72 h ($P<0.001$).

It is concluded that hypertrophy makes a major contribution to the observed uterotrophic response to tamoxifen.

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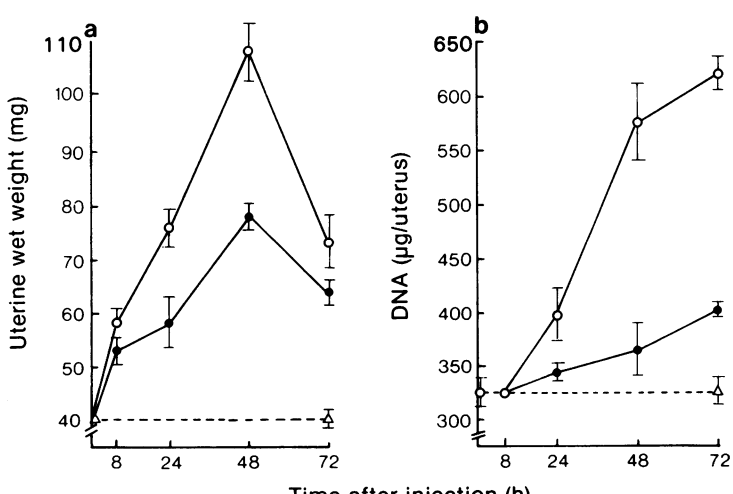

Figure 1 (a) Mean uterine wet weight in mg±s.e. mean (n=12) and (b) Mean uterine DNA content in μg per uterus ±s.e. (n=4) in immature female rats injected with either oestradiol benzoate (25 μg, O), tamoxifen (25 μg, ●), or saline (Δ). Each DNA analysis was carried out on three pooled uteri.

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Action of α-chlorohydrin on transporting functions of the rat cauda epididymidis

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α-Chlorohydrin (3-chloro-1,2-propanediol) has an anti-fertility effect in male rats (Ericsson, 1970). The mechanism of action of this compound is unknown but previous studies have indicated multiple sites of action. The motility, enzyme activities and the metabolism of the epididymal spermatozoa are known to be affected. It is not certain whether α-chlorohydrin acts directly on the epididymal spermatozoa or through its action on the functions of the epididymal epithelium. In this communication we report that low doses of α-chlorohydrin affect transport processes in the rat cauda epididymidis studied *in vitro* and *in vivo*.

Fertile male Sprague-Dawley rats weighing between 350–450 g were used. α-Chlorohydrin (99% pure) diluted with 0.9% saline was injected i.p. in rats at doses ranging from 0.9 to 18 mg kg^{-1} day^{-1} for seven days. The rate of fluid reabsorption of the isolated duct of the rat cauda epididymidis was measured by a visual method as described previously (Wong & Yeung, 1977a). The rate of fluid reabsorption in rats treated with α-chlorohydrin (0.9 and 3 mg kg^{-1} day^{-1}) were not significantly different from the control rate of 2.30 ± 0.14 μl^{-1} cm^{-2} 30 min^{-1} (mean ± s.e. mean, n = 6) obtained from untreated rats. In rats treated with α-chlorohydrin (9 mg kg^{-1} day^{-1} for 7 days), fluid reabsorption rate was 1.34 ± 0.13 μl^{-1} cm^2 30 min^{-1} (mean ± s.e. mean, n = 10), indicating inhibition of 42% ($P < 0.001$, Student's t test). Treatment of rats with α-chlorohydrin (9 mg kg^{-1} day^{-1} for 14 days) or (18 mg kg^{-1} day^{-1} for 7 days) showed no further inhibition. The effect of α-chlorohydrin treatment was completely reversible within 7 days of cessation of treatment. Ethylene chlorohydrin (Carlo Erba), which has a structure similar to that of α-chlorohydrin but produces no antifertility effect in male rats, did not affect fluid reabsorption in the rat cauda epididymidis. The action of α-chlorohydrin was found to be dependent on the presence of intraluminal Na^+ ions.

Reabsorption of sodium and water and secretion of potassium and proteins were also studied in the rat cauda epididymidis perfused with Krebs bicarbonate solution *in vivo* (Wong & Yeung, 1977b). Water reabsorption was measured by using [^{3}H]-inulin as volume marker and the net electrolyte fluxes were determined from the knowledge of the net water reabsorption rate and the initial and final electrolyte concentrations in the perfusing solutions. In normal rats, the rates of net sodium and water reabsorption were 3.00 ± 0.25 nEq cm^{-1} min^{-1} (mean ± s.e. mean, n = 14) and 20.7 ± 1.7 nl cm^{-1} min^{-1} (mean ± s.e. mean, n = 14) respectively. K^+ was found to be secreted into the ductal lumen at a rate of 0.124 ± 0.016 nEq cm^{-1} min^{-1} (mean ± s.e. mean, n = 14). The secretion rate of proteins was 11.7 ± 1.8 ng cm^{-1} min^{-1} (mean ± s.e. mean, n = 11). When α-chlorohydrin (9 mg kg^{-1} day^{-1}) was injected into male rats, the reabsorption rates of Na^+ and water were inhibited by about 50% ($P < 0.001$, Student t test). However, the net secretion rates of potassium and proteins were not affected. The sodium and water reabsorption rates were completely restored within one week of cessation of treatment with α-chlorohydrin.

The results indicate that α-chlorohydrin inhibits sodium and water reabsorption in the rat cauda epididymidis when given at dose rate known to produce sterility in male rats.

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