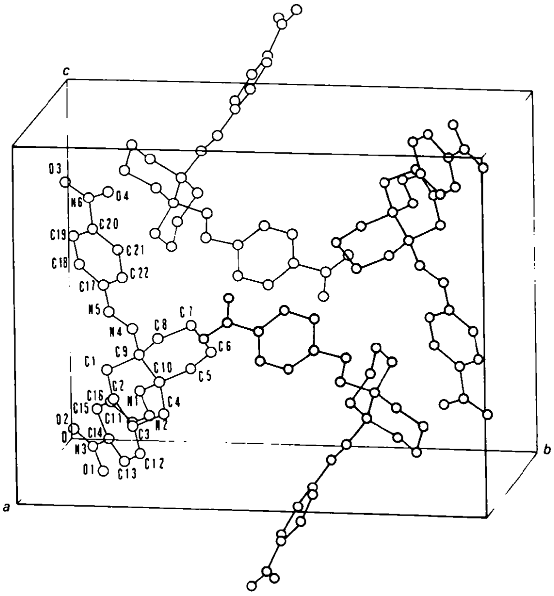

Fig. 2. Clinographic projection of the unit cell showing the molecular packing.

The geometrical features of the benzene rings are normal with average C—C distances 1·35 Å and 1·37 Å and with average bond angles 120°. The two rings form an angle of 66·3 (1)° with each other.

The N—O distances in the NO_2 groups, 1·17, 1·18, 1·22 and 1·24 Å, are in good agreement with the values 1·14–1·21 (4) Å given in *International Tables for X-ray Crystallography* (1968) and the values 1·19 (2) –1·25 (2) Å in dimethyl 3-(*p*-nitrophenyl)-4-oxo-6,6a-diphenyl-3a,4-dihydro-6a*H*-cyclopenta[2,3-*d*]-isoxazole-3a,5-dicarboxylate (Stergiou, Kokkou & Rentzeperis, 1978).

A clinographic projection of the structure, showing the molecular packing in the unit cell, is given in Fig. 2.

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(±)-Norphenylephrine Hydrochloride (*m*-Octopamine Hydrochloride), $C_8H_{12}NO_2^+.Cl^-$*

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Abstract. $M_r = 189.5$, monoclinic, $P2_1/n$, $a = 11.071$ (2), $b = 5.879$ (2), $c = 14.310$ (3) Å, $\beta = 104.00$ (2)°, $V = 903.7$ Å^3, $Z = 4$, $D_m = 1.42$, $D_x = 1.39$ g cm^{-3}, Mo $K\alpha$, $\lambda = 0.70926$ Å, $\mu = 4.0$ cm^{-1}, $F(000) = 400$, $T = 293$ K, $R = 0.032$ for 1293 observed reflections. The aminoethanol side chain is in the unusual *gauche* conformation with CC—CN and

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* Norphenylephrine is 2-amino-1-(3-hydroxyphenyl)ethanol.

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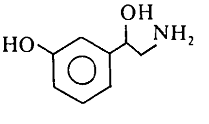
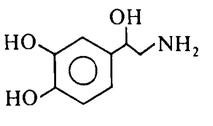
OC—CN torsion angles of 60·9 (3) and −64·1 (3)°, respectively. The phenyl ring plane is oriented essentially at right angles to the plane of the side chain [interplanar angle 89·5 (3)°]. The chloride ion is hydrogen bonded to three H atoms of symmetry-related $-N^+H_3$ groups [N···Cl 3·219 (3)–3·349 (3) Å] and to the *m*-hydroxy group [O···Cl 3·053 (3) Å]. Hydrogen bonding is completed by an O—H···O bond [O···O 2·828 (3) Å] between the side-chain hydroxyl and the *m*-hydroxy oxygen of an adjacent molecule.

Introduction. Norphenylephrine (1) is an α-adrenoreceptor stimulant closely related to noradrenaline (2). It has a hypertensive effect and its high activity is very similar to adrenal medullary hormones, but it possesses a very low degree of toxicity (Parvez, 1977).


(1)


(2)

The crystal structure of (1).HCl was initially determined from photographic data (Parvez, 1977) as part of a series of studies on the crystal structures of related adrenergic phenylethylamine derivatives in which their structural features and stereochemistry were compared and correlated with differences in physiological activities. We report here the crystal structure of (1).HCl determined with a higher precision from diffractometer data.

Table 1. *Final fractional coordinates* (×10⁵ *for* Cl, *remainder* ×10⁴) *with e.s.d.'s in parentheses and* U_{eq}(Å² × 10³)

	x	*y*	*z*	U_{eq}/U_{iso}†
Cl	24516 (4)	15523 (9)	12458 (3)	38 (1)
O(1)	−2132 (1)	5525 (3)	4394 (1)	49 (1)
O(2)*	−899 (1)	3623 (3)	656 (1)	43 (1)
O(2′)	−1849 (17)	4803 (34)	718 (13)	41 (6)
N	1173 (2)	6609 (3)	1498 (1)	37 (1)
C(1)	−826 (2)	4433 (3)	2344 (1)	32 (1)
C(2)	−1513 (2)	5391 (3)	2936 (1)	35 (1)
C(3)	−1398 (2)	4556 (3)	3857 (1)	33 (1)
C(4)	−597 (2)	2766 (3)	4201 (1)	38 (1)
C(5)	103 (2)	1828 (3)	3613 (1)	41 (1)
C(6)	−21 (2)	2657 (3)	2683 (1)	38 (1)
C(7)	−1027 (2)	5339 (4)	1317 (1)	39 (1)
C(8)	−158 (2)	7256 (3)	1223 (1)	37 (1)

* O(2) and O(2′) are the disordered side-chain oxygens with occupancy factors 0·92 and 0·08, respectively.

† $U_{eq} = (U_{11} + U_{22} + U_{33})/3$ except for O(2′) which was refined isotropically.

Table 2. *Molecular dimensions* (Å, °)

O(1)—C(3)	1·370 (2)	C(5)—C(6)	1·393 (3)
C(1)—C(2)	1·387 (3)	C(7)—C(1)	1·529 (2)
C(1)—C(6)	1·382 (3)	C(7)—C(8)	1·509 (3)
C(2)—C(3)	1·383 (2)	C(7)—O(2)	1·414 (2)
C(3)—C(4)	1·387 (3)	C(8)—N	1·480 (3)
C(4)—C(5)	1·389 (3)	C(7)—O(2′)	1·133 (18)
C(2)—C(1)—C(6)	119·7 (2)	C(4)—C(5)—C(6)	120·0 (2)
C(2)—C(1)—C(7)	118·1 (2)	C(5)—C(6)—C(1)	120·4 (2)
C(6)—C(1)—C(7)	122·2 (2)	C(1)—C(7)—C(8)	113·5 (1)
C(1)—C(2)—C(3)	120·0 (2)	C(1)—C(7)—O(2)	112·3 (2)
C(2)—C(3)—C(4)	120·8 (2)	C(7)—C(8)—N	113·6 (2)
C(2)—C(3)—O(1)	117·2 (2)	C(8)—C(7)—O(2)	107·7 (2)
C(4)—C(3)—O(1)	122·1 (2)	C(1)—C(7)—O(2′)	122·3 (9)
C(3)—C(4)—C(5)	119·2 (2)	C(8)—C(7)—O(2′)	123·6 (9)

Experimental. Colourless crystals from *n*-butanol, 0·50 × 0·20 × 0·14 mm, D_m by flotation, Enraf–Nonius CAD-4 diffractometer, graphite monochromated Mo *K*α radiation, 25 reflections with $10 < \theta < 15°$ used to determine cell constants, $2 < \theta < 25°$ intensity data, ω–2θ scans, ω scan width (0·70 + 0·35 tanθ)°, three standard reflections monitored every hour of exposure time – no significant variation, Lp corrections, 1566 reflections, 1293 (82·6%) with $I > 3\sigma(I)$, where $\sigma^2(I) = S + 2B + [0{\cdot}04(S - B)]^2$, *S* = scan count and *B* = time-averaged background count. *h* 0–±12, *k* 0–6, *l* 0–15. Structure solved by heavy-atom method using *SHELX*76 (Sheldrick, 1976) and refined by full-matrix least-squares calculations on *F*. During the course of the refinement, a peak was found adjacent to the carbon of the CHOH moiety consistent with there being a small amount of the corresponding unreduced carbonyl precursor, $HO-C_6H_4-CO-CH_2N^+H_3$. This was allowed for by appropriate occupancy factor refinement which showed that there was 8% of the carbonyl derivative in the sample (see *Discussion*). H atoms, from difference syntheses, included at idealized positions (C—H, O—H and N—H 0·95 Å) but not refined. Final $R = 0{\cdot}032$, $R_w = [\sum w\Delta^2/\sum wF_o^2]^{1/2} = 0{\cdot}041$ for 1293 observed data, $w^{1/2} = 1/[\sigma^2(F) + 0{\cdot}002F^2]^{1/2}$, ±0·2 e Å^{-3} in final difference map, $(\Delta/\sigma)_{max} = 0{\cdot}09$ for U_{23} of C(2), $(\Delta/\sigma)_{mean} = 0{\cdot}04$. Atomic scattering factors from Cromer & Mann (1968) and Stewart, Davidson & Simpson (1965), allowance made for anomalous dispersion (Cromer & Liberman, 1970). Other computer programs used included *XANADU* (Roberts & Sheldrick, 1975) and *ORTEP*II (Johnson, 1976). Final fractional coordinates with mean isotropic temperature factors are in Table 1. Table 2 contains molecular dimensions.*

Discussion. Catecholamines such as (2) and their analogues have been found to occur in the fully extended (*anti*) conformation in the solid state, *e.g.* (−)-adrenaline hydrogen (+)-tartrate (Carlström,

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* Lists of structure factors, anisotropic thermal parameters, calculated hydrogen coordinates, hydrogen-bonding scheme, selected torsion angles and mean-plane calculations have been deposited with the British Library Lending Division as Supplementary Publication No. SUP 39404 (11 pp.). Copies may be obtained through The Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

1973), (−)-adrenaline (Andersen, 1975*a*), (−)-noradrenaline hydrochloride (Carlström & Bergin, 1967), (−)-noradrenaline (Andersen, 1975*b*), adrenalone hydrochloride monohydrate (Bergin, 1971), dopamine hydrochloride (Bergin & Carlström, 1968), (−)-phenylephrine (Andersen, 1976), (±)-isoprenaline sulfate dihydrate (Mathew & Palenik, 1971), (±)-isoprenaline (Parvez, 1977), (±)-salbutamol (Beale & Stephenson, 1972), (±)-*p*-octopamine hydrochloride (Paxton & Hamor, 1977) and (±)-*o*-octopamine hydrochloride (Makriyannis, Anderson, Dipiro, Kostiner & Hite, 1979). In the crystal structure of (1).HCl the cation adopts the *gauche* conformation shown in Fig. 1 with torsion angles close to the 60° *gauche* value. The plane of the side chain comprising C(1),C(7),C(8) is perpendicular to the plane of the phenyl ring. *gauche* conformations for the $-CHOHCH_2N^+H_3$ side chain are not unknown in other related molecules and have been observed in (±)-norephedrine (Parvez, 1977) and (±)-norephedrine hydrochloride (Herbert, 1979); in the latter case, however, the asymmetric unit consisted of two independent molecules one with an *anti* and the other with a *gauche* conformation. Whether a *gauche* or *anti* conformation about the C(7)—C(8) bond is adopted in the solid state is clearly under crystal packing control. In *o*-octopamine hydrochloride (Makriyannis *et al.*, 1979) with the *anti* conformation, there is an intramolecular OH···O hydrogen bond, and the terminal $-N^+H_3$ group is hydrogen bonded to two Cl^- ions and a side-chain OH of a related ion; in *p*-octopamine hydrochloride (Paxton & Hamor, 1977) the same type of inter-ion hydrogen bonding is observed. The hydrogen bonding in (1).HCl is shown in Fig. 2. In this system the $-N^+H_3$ moiety is hydrogen bonded to three symmetry-related Cl^- ions. Inter-ion bonding in the solid is completed by the side-chain OH group hydrogen bonding to the *m*-hydroxy group of an adjacent molecule, which in turn is hydrogen bonded to a Cl^- ion.

Bond lengths and angles in (1).HCl (Table 2) are normal. The phenyl ring is planar to within 0·006 (2) Å with O(1) −0·038 (2) and C(7) −0·064 (2) Å from this plane. Our analysis also indicated the presence (8%) of some unreduced carbonyl precursor in the crystal studied. A similar situation has also been found in *o*-octopamine hydrochloride (Makriyannis *et al.*, 1979), where the amount of carbonyl derivative was much greater (26·5%).

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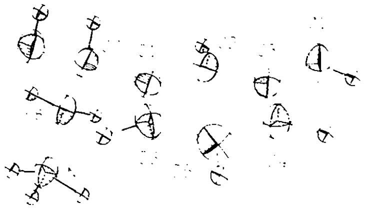

Fig. 1. A perspective view of the $HO-C_6H_4-CHOH-CH_2-N^+H_3$ cation with the crystallographic numbering scheme.

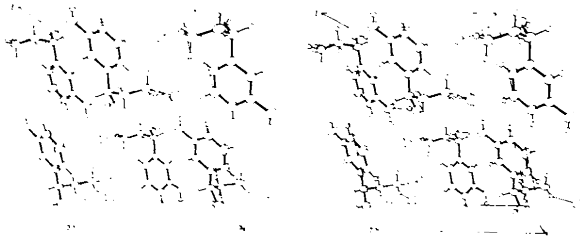

Fig. 2. A stereoview of the unit cell showing hydrogen bonds.

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