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COMPARISON OF THE EFFECTS OF ULTRAVIOLET LIGHT AND PURINERGIC NERVE STIMULATION ON THE GUINEA-PIG TAENIA COLI

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1 The responses of the guinea-pig taenia coli, urinary bladder and the rabbit portal vein to ultraviolet (u.v.) light were compared to those elicited by purinergic nerve stimulation and exogenous adenosine triphosphate (ATP).

2 In the presence of sodium nitrite, u.v. light between 340–380 nm produced a maximum relaxation of the taenia coli. The relaxation was reversible and fast in onset. It was unaffected by atropine, guanethidine or low concentrations of phentolamine or propranolol. When the tone was low, the relaxation was usually followed by a 'rebound contraction' upon cessation of stimulation. Thus, the response to u.v. light closely resembles the responses to both purinergic nerve stimulation and exogenously applied ATP.

3 U.v. light did not initiate impulses in purinergic nerves since its action was unaffected by tetrodotoxin; nor did it release ATP from nerve terminals (in contrast to its release during purinergic nerve stimulation). The adenosine-uptake inhibitor, dipyridamole, which potentiates the responses to purinergic nerve stimulation and ATP, did not affect the response to u.v. light.

4 Agents known to alter postjunctional responses to purinergic nerve stimulation and ATP also altered the response to u.v. light. High concentrations of the 2-substituted imidazoline compounds, antazoline and phentolamine, which antagonize the responses to purinergic nerve stimulation and ATP, reduced the responses to u.v. irradiation. The prostaglandin synthesis inhibitor, indomethacin, which abolishes the 'rebound contraction' following stimulation of purinergic nerves, also blocks the 'rebound 'contraction' following u.v. irradiation. Increases in the K^+ concentration produced parallel changes in the inhibitory responses to u.v. light and purinergic nerve stimulation.

5 U.v. light produced relaxation and inhibition of spontaneous activity of the rabbit portal vein (relaxed by ATP), but had no effect on the guinea-pig urinary bladder (contracted by ATP) and ureter (unaffected by ATP).

6 It is suggested that u.v. light is acting on some part of the purinergic receptor complex which is involved in the mediation of inhibitory responses to ATP and purinergic nerve stimulation, and may therefore provide a way of investigating the chemistry of inhibitory purinergic receptors.

Introduction

Mammalian isolated vascular smooth muscle relaxes when exposed to intense visible or ultraviolet (u.v.) light (Furchgott, Ehrreich & Greenblatt, 1961; Furchgott, 1962). Non-vascular smooth muscle is much less sensitive to u.v. irradiation, but the sensitivity of such tissues is increased considerably in the presence of nitrite ion (Ehrreich & Furchgott, 1968).

In preliminary experiments, we found that strips of guinea-pig taenia coli treated with nitrite ion relaxed when exposed to u.v. light and the relaxation was followed by a 'rebound contraction' on cessation of irradiation. These responses were not modified by atropine or guanethidine and were reversible. These characteristics of the response to u.v. irradiation are strikingly similar to those responses of the taenia coli resulting from stimulation of non-cholinergic, non-adrenergic, inhibitory ('purinergic') nerves (see Burnstock, Campbell & Rand, 1966; Burnstock, 1975). Thus in the present experiments we have examined the effect of various treatments, shown to modify the responses of the guinea-pig taenia coli to purinergic nerve stimulation, on the responses to u.v. light. The effect of u.v. light on the guinea-pig urinary bladder (considered to be innervated by excitatory purinergic nerves; Burnstock, Dumsday & Smythe, 1972), rabbit portal vein (considered to be innervated by purinergic

vasodilator nerves; Su & Lee, 1976) and ureter (not innervated by purinergic nerves) was also studied.

Methods

Guinea-pigs of either sex, weighing between 400 and 600 g, were stunned and bled. Taenia coli strips of 1 to 1.5 cm length were prepared according to the method of Burnstock *et al.* (1966). Bladder strips, of 2 mm width and 1 to 1.5 cm in length were prepared according to the method of Ambache & Zar (1970). Sections of ureter 1.5 to 2 cm in length were removed about 1 cm away from the kidneys. Rabbits weighing between 2–3 kg were killed by cervical dislocation. Strips of portal vein, starting at the junction of the splenic and the superior mesenteric veins and ending at its bifurcation into left and right branches, were removed. Tissue strips were mounted vertically under 1 g tension and superfused with a modified Krebs solution (Bülbring, 1953) containing guanethidine (5×10^{-6} M) and atropine (1.5×10^{-7} M), at a rate of 1–2 ml/minute. In experiments where the K^+ concentration was increased, the osmolarity of the medium was kept constant by deletion of an appropriate amount of NaCl. Low calcium Krebs solution contained $CaCl_2$ 0.1 mM. The medium was kept at 37°C and bubbled with 95% O_2 and 5% CO_2. Square wave pulses at various frequencies, pulse duration of less than 1 ms and supramaximal voltage (between 30 and 50 V, depending largely on the size of the preparation and the position of the electrodes) were delivered through bipolar platinum ring electrodes connected to a Grass S44 electronic stimulator.

The u.v. light source (Farrand 150 W high pressure xenon arc lamp fitted with a Farrand Foci f/3.5 grating monochromator, which allowed variation in intensity and wavelength of illumination) was placed 12 cm from the tissue. The output of the monochromator was focussed by a lens located midway between the monochromator and the tissue. Focussing was achieved by initial use of visible light (550 nm).

Adenosine triphosphate (ATP) and noradrenaline were superfused over the tissues in volumes of 0.2 ml to 0.4 ml at a constant rate for 5 s and 10 s respectively with a syringe. The other drugs were superfused continuously for specified periods of time. Changes in length of the taenia were recorded isotonically, except for the experiments with [^{3}H]-adenosine, which were carried out under isometric conditions. Recordings were made with a Grass FT 10 transducer and a Grass Model 79D polygraph. Responses of the portal vein and bladder were recorded isometrically with a Dynamometer UFI strain gauge. Drugs used were: adenosine triphosphate disodium salt (Aldrich); antazoline hydrochloride (CIBA); atropine sulphate (Antigen Ltd.); dipyridamole (Boehringer); guanethidine sulphate (CIBA); noradrenaline tartrate (Winthrop); phentolamine mesylate (CIBA); sodium nitrite (Fisons); tetrodotoxin (Sigma) and [^{3}H]-adenosine (Amersham Radiochemicals).

All drugs were dissolved in Krebs physiological solution and concentrations are expressed in terms of the forms given above. Noradrenaline was dissolved in Krebs physiological solution containing disodium edetate (EDTA, 0.13 M) and ascorbic acid (0.28 M) to retard oxidation.

For studies with [^{3}H]-adenosine, the taenia coli strips were incubated for 1 h in 10 ml of Krebs solution in a jacketed organ bath at 37°C with [^{3}H]-adenosine (10^{-7} M; specific activity 21 Ci/mmol). The incubation solution was gassed with a mixture of 5% CO_2 in O_2. At the end of the incubation period, the tissues were washed briefly in adenosine-free Krebs solution, mounted vertically under 1 g tension, and superfused with adenosine-free Krebs for 1 hour.

After 1 h, the taenia coli strips were stimulated either with u.v. light, at 360 nm for 30 s, or with 30 s trains of pulses at a frequency of 5 hertz. These stimuli were delivered at 30 min intervals. For each stimulation, 7 successive 30 s fractions of the superfusate were collected, 2 samples before the period of stimulation and the rest during and after stimulation. For radioactivity counting, a 1 ml aliquot of each fraction was mixed with 10 ml of liquid scintillation solution containing 55 mg of 2-5-diphenyloxazole (PPO), 1 mg of 1,4-bis-2-(5-phenyloxazolyl)-benzene (POPOP), 3.3 ml of Triton-X and the balance toluene. The samples were counted for 20 min in an ABAC SL 40 liquid scintillation counter.

For measurement of ATP release, samples were assayed for ATP by the sensitive luciferin-luciferase firefly reaction ATP-assay method (McElroy, Seliger & White, 1969).

Results

Characteristics of the response to ultraviolet light in the taenia coli

In the absence of sodium nitrite, irradiation with u.v. light (280 to 420 nm) had little effect on strips of guinea-pig taenia coli. After treatment with sodium nitrite (2.9×10^{-4} M to 1.4×10^{-3} M), marked relaxation of the tissue occurred 1.5 s to 2 s after starting irradiation. On cessation of irradiation, the relaxation was followed by a return to resting tension, or in tissues with a low basal tension, it was followed by a 'rebound contraction' (Figure 1). This 'rebound contraction' was similar to that which characteristically follows the response to purinergic nerve stimulation and the application of ATP. It also resembles the

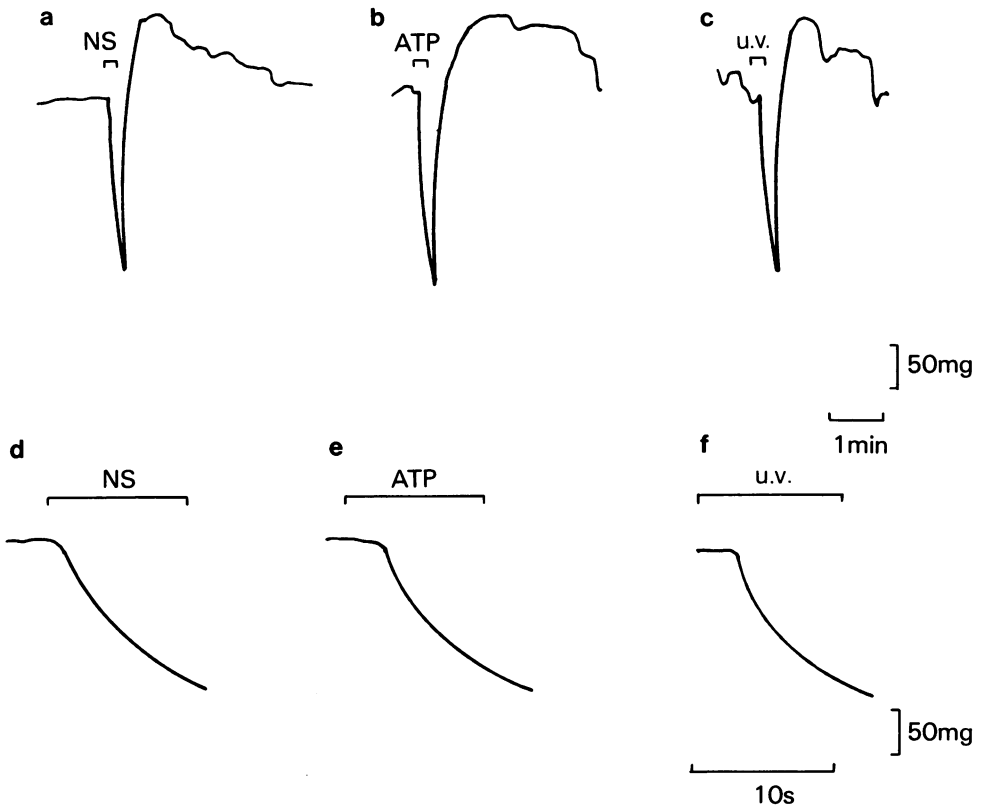

Figure 1 Responses of the guinea-pig taenia coli to (a) intramural nerve stimulation (NS, 1 Hz, 0.5 ms pulse duration, for 10 s at supramaximal voltage) (b) ATP (2×10^{-6} M) and (c) u.v light (340 nm for 10 seconds). The responses consist of a relaxation followed by a 'rebound contraction'. (d, e & f) Responses to the same stimuli recorded at high chart speed. Atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M) were present.

post-irradiation stimulation observed by Ehrreich & Furchgott (1968) in rabbit stomach strips.

The magnitude of relaxation to u.v. irradiation increased as the concentration of sodium nitrite in the superfusate was increased from 2.9×10^{-4} M to 1.4×10^{-3} M. Sodium nitrite alone is a smooth muscle relaxant and caused a slight loss of resting tension. Since the magnitude of relaxation of the taenia on exposure to u.v. light was dependent on the level of resting tension before illumination, a concentration of 7.2×10^{-4} M sodium nitrite was used for the rest of the experiments as this produced a good sensitization of the taenia to u.v. light without a significant loss of resting tension. Maximum relaxation was obtained in the u.v. range of 340 nm to 380 nm (Figure 2). When the duration of irradiation was increased, there was an increased relaxation; maximum magnitude was usually attained after 15 s to 20 s exposure, but in some preparations, the response did not reach a maximum until more than 60 s (Figure 3). In low or medium tone preparations, where there was a rebound contraction, the magnitude of this contraction was greater with increasing duration of irradiation. In most preparations, prolonged u.v. irradiation for up to 12 min caused a sustained relaxation, but sometimes the tension returned to control values before the irradiation period was complete. When this occurred, the relaxation to intramural nerve stimulation was inhibited by 30%; this response gradually returned to normal after cessation of u.v. irradiation (Figure 4).

The response to u.v. light was completely reversible, and in common with the response to intramural nerve stimulation, does not exhibit fatigue even after 6 h of continuous stimulation (Figure 5). When ultraviolet irradiation and intramural stimulation were delivered

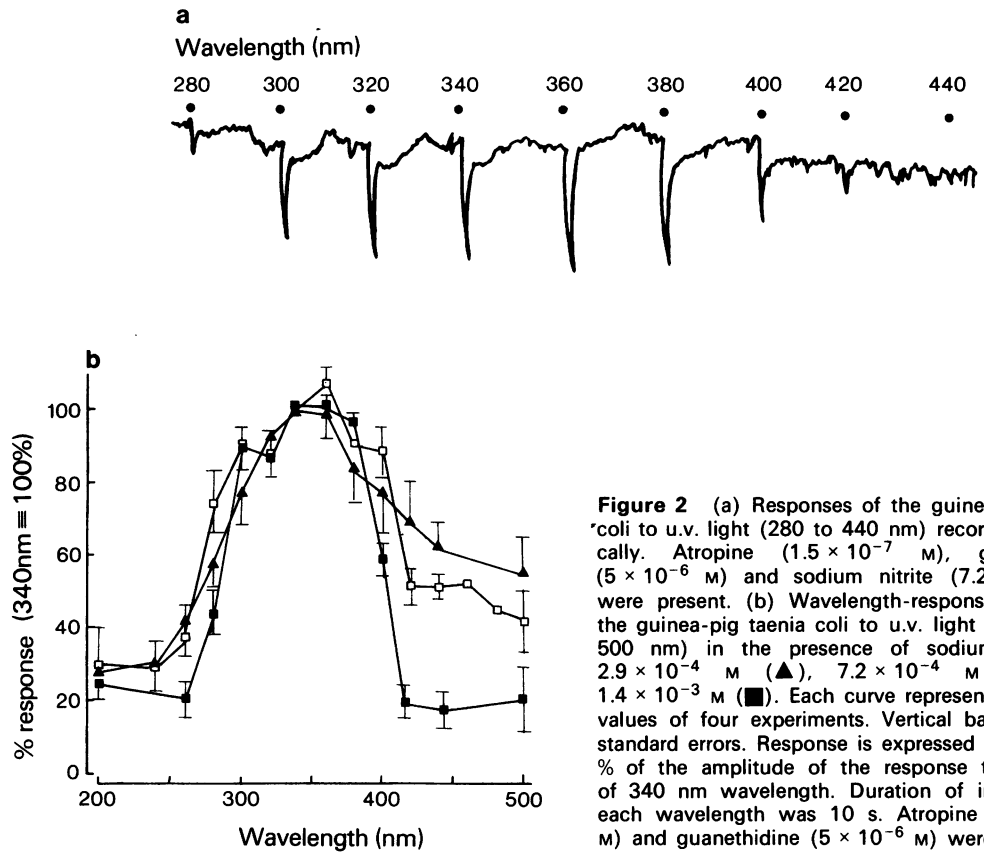

Figure 2 (a) Responses of the guinea-pig taenia coli to u.v. light (280 to 440 nm) recorded isotonically. Atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M) were present. (b) Wavelength-response curves of the guinea-pig taenia coli to u.v. light (200 nm to 500 nm) in the presence of sodium nitrite at 2.9×10^{-4} M (▲), 7.2×10^{-4} M (□) and 1.4×10^{-3} M (■). Each curve represents the mean values of four experiments. Vertical bars represent standard errors. Response is expressed arbitrarily as % of the amplitude of the response to u.v. light of 340 nm wavelength. Duration of irradiation at each wavelength was 10 s. Atropine (0.5×10^{-7} M) and guanethidine (5×10^{-6} M) were present.

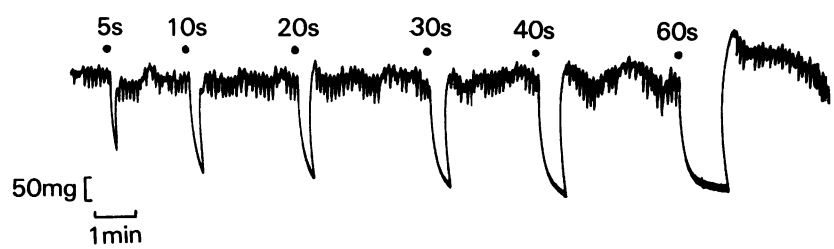

Figure 3 Effect of duration (5 s to 60 s) of u.v. irradiation (340 nm) on the responses of the guinea-pig taenia coli. Atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M) were present.

simultaneously, the amplitude of the relaxation in response to these two stimuli was less than the summed amplitudes of the responses when delivered separately even though the tissue was capable of further relaxation (Figure 6). However, this type of interaction was also observed when either ATP or noradrenaline (NA) was administered simultaneously with u.v. irradiation.

Effect of drugs on the response to ultraviolet light

Tetrodotoxin. (3×10^{-6} M to 6×10^{-6} M) which paralyses autonomic nerves but not smooth muscle (see Kao, 1966) abolished the responses of the taenia coli to intramural nerve stimulation but had no effect on the responses to u.v. light or ATP (Figure 7).

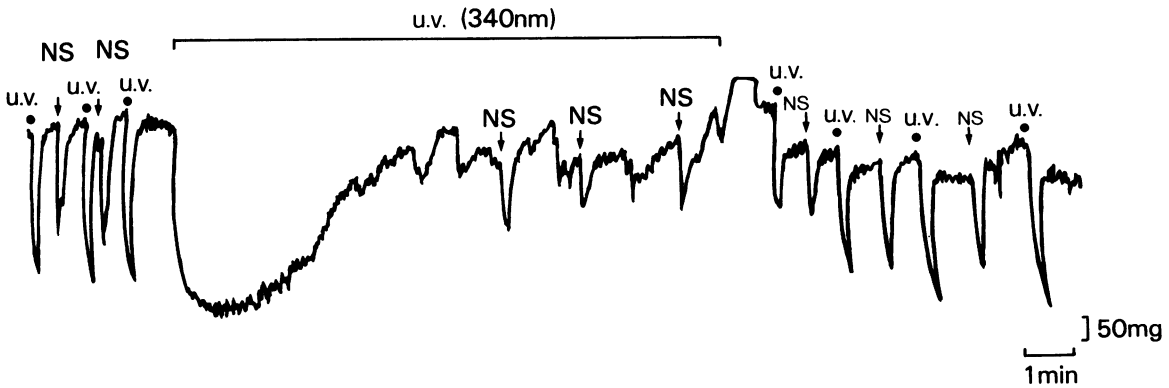

Figure 4 Responses of the guinea-pig taenia coli to intramural nerve stimulation (NS at 1 Hz, 0.5 ms pulse duration, and supramaximal voltage for 10 s) were diminished when there was a loss of sensitivity to u.v. light after prolonged irradiation (at 340 nm for 15 minutes). Atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M) were present.

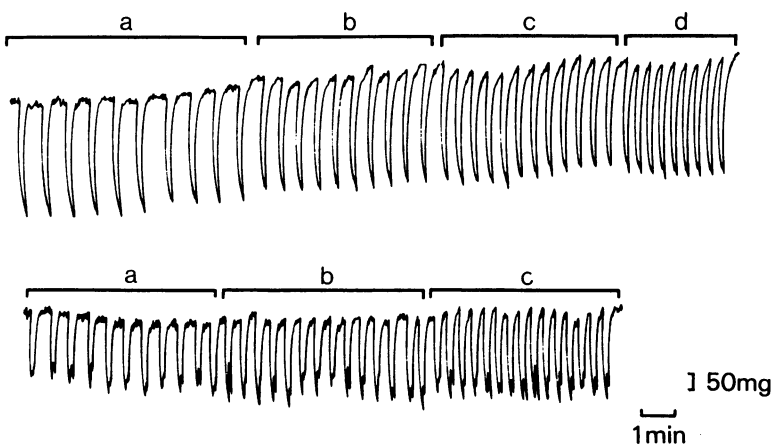

Figure 5 Upper trace: responses of the guinea-pig taenia coli to u.v. light (340 nm for 10 s period of irradiation) every 30 s (a), 20 s (b), 15 s (c) and 10 s (d). Lower trace: responses of the guinea-pig taenia coli to intramural nerve stimulation (at 1 Hz, 0.5 ms pulse duration, and supramaximal voltage for 10 s every 20 s (a) 15 s (b) and 10 s (c). Atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M) were present.

Atropine and guanethidine. The response to u.v. irradiation was unaffected by the presence of the muscarinic receptor blocker atropine (1.5×10^{-7} M), or the adrenergic neurone blocker, guanethidine (5×10^{-6} M to 5×10^{-4} M).

Propranolol, phentolamine and antazoline. Low concentrations of propranolol (5×10^{-7} M) and phentolamine (5×10^{-6} M), which are known to block adrenoceptors, had no effect on the response to u.v. irradiation.

High concentrations of either of the α-adrenoceptor antagonists phentolamine or antazoline have been shown to inhibit the responses to purinergic nerve stimulation and exogenous ATP in the guinea-pig taenia coli (Satchell, Burnstock & Dann, 1973). In the experiments described here, phentolamine (1.8×10^{-4} M) reduced the responses to intramural nerve stimulation and u.v. irradiation in parallel while the responses to ATP were abolished (Figure 8). At this concentration the effects of phentolamine were irreversible. A lower concentration of phentolamine (9×10^{-5} M) reduced the responses to ATP by 30

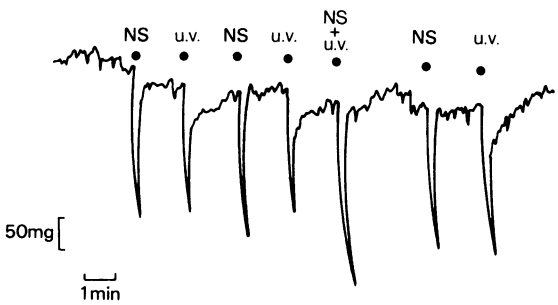

Figure 6 Interaction of the responses of the guinea-pig taenia coli to intramural nerve stimulation (NS, at 5 Hz, 0.5 ms pulse duration and supramaximal voltage for 10 s) and u.v. light (340 nm for 10 s) when the two stimuli are delivered simultaneously. Atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M) were present.

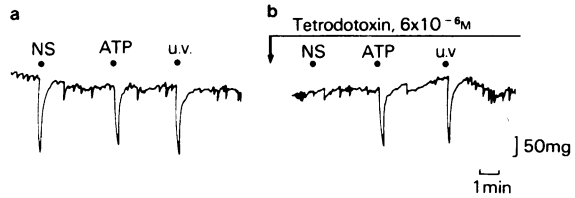

Figure 7 Responses of the guinea-pig taenia coli to intramural nerve stimulation (NS, at 1 Hz, 0.5 ms pulse duration and supramaximal voltage for 10 s), ATP (2×10^{-6} M for 10 s) and u.v. light (340 nm for 10 s) (a) before and (b) after the addition of tetrodotoxin (6×10^{-6} M) for 15 minutes. Atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M) were present.

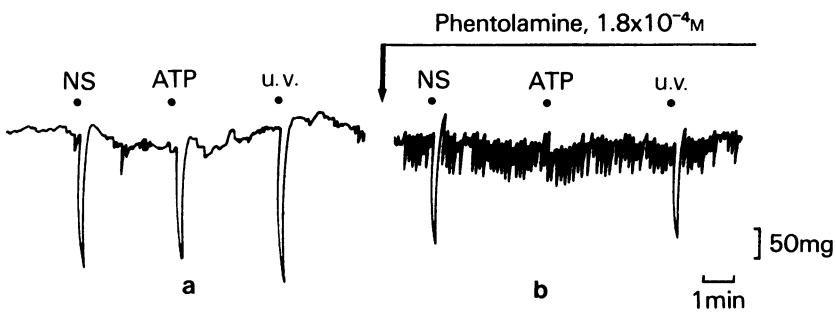

Figure 8 Responses of the guinea-pig taenia coli to intramural nerve stimulation (NS, at 1 Hz, 0.5 ms pulse duration and supramaximal voltage for 10 s), ATP (2×10^{-6} M for 10 s) and u.v. (340 nm for 10 s) (a) before, and (b) after the addition of phentolamine (1.8×10^{-4} M) for 15 minutes. Atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M) were present.

to 90%, but had no effect on responses to intramural stimulation or u.v. irradiation. Antazoline (1.8×10^{-4} M) abolished the response to ATP, while the response to u.v. light was either abolished or substantially reduced. The extent of reduction of the response to intramural nerve stimulation by antazoline was variable. At a lower concentration of 9×10^{-5} M, antazoline abolished the response to ATP but had no effect on the response to intramural nerve stimulation; the response to u.v. light was reduced in three out of six of these experiments.

Indomethacin. The prostaglandin synthesis inhibitor, indomethacin (2×10^{-5} M to 5×10^{-5} M), which has been shown to block the 'rebound contraction' which follows the relaxation to intramural nerve stimulation and exogenous ATP in the taenia coli (Burnstock, Cocks, Paddle & Staczewska-Barzcak, 1975), also abolished the rebound contraction following the relaxation to u.v. irradiation.

Dipyridamole. (5×10^{-7} M to 10^{-6} M), which has been reported to potentiate the effects of both ATP and intramural nerve stimulation on the guinea-pig taenia coli (Satchell, Lynch, Bourke & Burnstock, 1972), did not significantly alter the response of nitrite-treated taenia coli to ultraviolet irradiation.

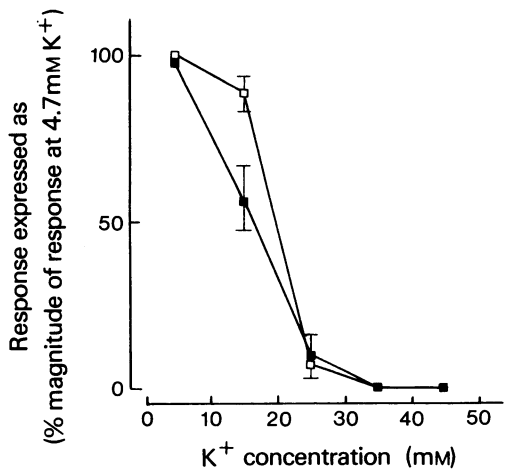

Figure 9 Effect of alteration of potassium ion concentration (abscissa scale) on the responses of the guinea-pig taenia coli to intramural nerve stimulation, (□, NS, at 1 Hz, 0.5 ms pulse duration and supramaximal voltage for 10 s), and u.v. light (■, 340 nm for 10 s), in the presence of atropine (1.5×10^{-7} M), guanethidine (5×10^{-6} M) and sodium nitrite (7.2×10^{-4} M). Each symbol represents the mean value of at least four experiments ± s.e. of the mean. Responses of the taenia coli expressed as % of the magnitude of the responses to these stimuli in control medium.

Effect of high K^+ and low Ca^{2+} ion concentrations

It has been shown that the responses to both intramural non-adrenergic inhibitory nerve stimulation and ATP are due to activation of receptors leading to a specific increase in K^+ conductivity (Bennett, Burnstock & Holman, 1963; Tomita & Watanabe, 1973; den Hertog & Jager, 1975). Raising the K^+ concentration in the Krebs superfusate caused a sustained contraction of the taenia. At 35 mM K^+, responses to intramural nerve stimulation and u.v. irradiation were completely abolished (Figure 9). After removal of the excess K^+ the tone of the taenia returned to prestimulation level rapidly and the responses to intramural nerve stimulation and u.v. irradiation all returned to control levels.

Reduction of the calcium concentration in the Krebs superfusate to 0.1 mM markedly reduced the responses to intramural nerve stimulation and ATP. The responses to u.v. irradiation were also considerably reduced or abolished.

Radioactivity and ATP release studies

It has been shown that [^{3}H]-adenosine is taken up by the taenia coli, converted and retained primarily as [^{3}H]-ATP. This tritium is released upon electrical stimulation of purinergic nerves (Su, Bevan & Burnstock, 1971). Therefore the effect of u.v. irradiation on the level of tritium in the superfusate from taenia coli previously incubated in [^{3}H]-adenosine (10^{-7} M) was investigated; irradiation (at 360 nm for 30 s periods) did not lead to tritium release, in contrast to the release resulting from intramural nerve stimulation. Similar results were obtained by measurement of the concentration of ATP in the superfusate by the luciferin-luciferase firefly assay method. (Table 1). There was no increase in ATP concentration in the superfusate during or after 30 s periods of u.v. irradiation.

Effect of ultraviolet light on other smooth muscle preparations

Rabbit portal vein. The rabbit portal vein has been reported by Hughes & Vane (1967) to contain a non-adrenergic inhibitory innervation and this has been considered to be purinergic (Su & Lee, 1976).

After addition of nitrite ion (7.2×10^{-4} M), irradiation with u.v. light (360 nm) caused an inhibition of spontaneous contractions and a relaxation when the tension of the preparation was raised.

Guinea-pig urinary bladder. Recent evidence has shown that atropine-resistant excitation of the guinea-pig urinary bladder may be mediated by purinergic nerves (Ambache & Zar, 1970; Burnstock *et al.*, 1972). U.v. light had no effect on this tissue, or on the contractions produced by intramural nerve stimulation (3 to 10 Hz) and ATP, (2×10^{-6} to 2×10^{-5} M) before or after treatment with nitrite ion (7.2×10^{-4} M) (Figure 10). U.v. light still had no effect when the tone of the preparation was raised by histamine.

Guinea-pig ureter. The smooth muscle coat in this tissue has been reported to be sparsely innervated but there is no evidence for a purinergic innervation (see Burnstock, 1970). No response to u.v. light was obtained, before or after treatment of the tissue with nitrite ion.

Discussion

Following the reports by earlier workers of irreversible contractions produced in visceral smooth muscle

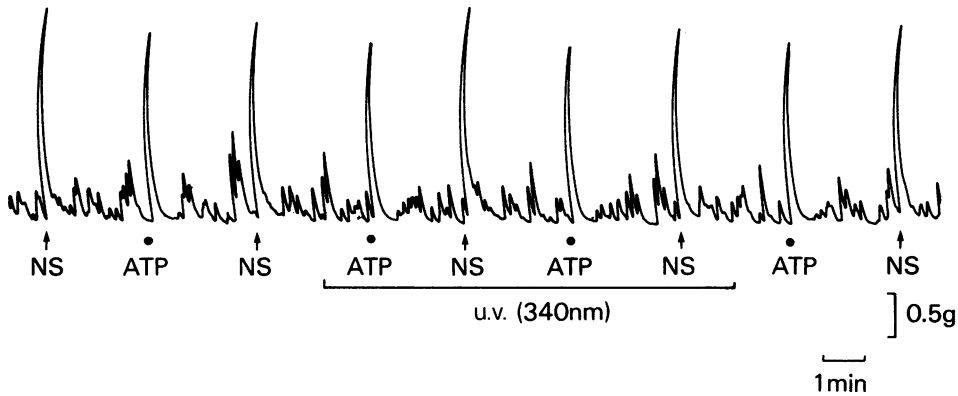

Figure 10 Responses of a strip of the urinary bladder of the guinea-pig to intramural nerve stimulation (NS, at 5 Hz, 0.5 ms pulse duration and supramaximal voltage for 10 s) were unaffected by u.v. light (340 nm). Sodium nitrite (7.2×10^{-4} M) was present.

and skeletal muscle by intense ultraviolet light below 320 nm (Azuma & Hill, 1926; Azuma, 1927), Furchgott and his colleagues discovered a readily reversible relaxation in the rabbit aorta strip using u.v. light at similar wavelengths (Furchgott *et al.*, 1961; Ehrreich & Furchgott, 1968). Non-vascular smooth muscle was found to be much less sensitive to u.v. irradiation but the sensitivity of such tissues was increased considerably in the presence of nitrite ion (Ehrreich & Furchgott, 1968). We found that u.v. irradiation caused relaxation of guinea-pig taenia coli strips in the presence of nitrite ion. Furthermore, the most effective wavelengths for this response were between 340 nm and 380 nm. There was a close similarity between the responses of the guinea-pig taenia coli to u.v. light and to purinergic nerve stimulation.

U.v. light may therefore act by initiating activity in purinergic nerves leading to the release of the transmitter ATP. Experiments on the isolated nodes of Ranvier of frogs by Fox & Stämpfli (1971) showed that sodium currents in voltage clamp experiments fell during u.v. irradiation at 280 nm while there was little change in potassium currents. Observations on single nerve fibres of crab (Lieberman, 1967) and

Table 1 Changes in the amount of ATP in the superfusate of guinea-pig taenia coli strips during relaxations produced by u.v. irradiation and purinergic nerve stimulation

Expt. no.	*Amplitude of relaxation (g)*	*Amount of ATP released ($g \times 10^{-10}$)*	
		Prestimulation	*Relaxation*
u.v. irradiation			
1.	1.70	2.60	2.78
2.	0.95	3.10	2.67
3.	0.55	2.66	2.32
4.	1.50	2.11	2.13
Mean ± s.e.		2.62 ± 2.02	2.48 ± 0.15
Purinergic nerve stimulation			
1.	0.35	3.89	9.30
2.	0.55	2.94	12.84
3.	0.45	2.27	14.04
4.	2.0	3.80	10.86
Mean ± s.e.		3.23 ± 0.37	11.76 ± 1.06*

Relaxations were recorded isometrically. U.v. irradiation was 340 nm for 30 s; stimulation was at 5 Hz, 0.3 ms pulse duration and supramaximal voltage for 30 seconds.
* significant, $P < 0.001$.

lobster (Oxford & Pooler, 1975) also showed an irreversible reduction in the magnitude of sodium conductance by u.v. light (255–305 nm). However, in the taenia coli, the effects of u.v. light are readily reversible and tetrodotoxin, which blocks sodium channels in nerve fibres (Kao, 1966), did not affect the response to u.v. irradiation.

U.v. light could also act by causing release of ATP from purinergic nerves in the taenia coli (without the initiation of a nerve impulse). An increase in the discharge frequency of miniature endplate potentials at the frog neuromuscular junction during u.v. irradiation with wavelengths shorter than 300 nm has been reported (Goto & Kuroda, 1975). As there was no change in the amplitude of individual miniature endplate potentials or in the resting potential of the post-synaptic membrane, this was attributed to a presynaptic action of u.v. light, producing increased release of transmitter from acetylcholine vesicles.

However, in the present study, there was no release of labelled ATP during u.v. irradiation of the taenia coli. Furthermore, dipyridamole, which potentiates the responses to purinergic nerves and ATP (Satchell *et al.*, 1972), did not affect the responses to u.v. light. It is also unlikely that release of transmitter from cholinergic or adrenergic systems is involved since atropine, guanethidine and low concentrations of phentolamine or propranolol had no effect on the response to u.v. irradiation.

The possibility remains that u.v. light is acting postsynaptically either at some site in the purinergic receptor complex or perhaps directly on mechanisms leading to relaxation such as the Ca^{2+} channels. Depolarization of the smooth muscle of the guinea-pig taenia coli with excess KCl abolished the response to u.v. light. This supports the view that u.v. light acts on the postsynaptic membrane and since occupation of purinergic receptors leads to a specific increase in K^+ conductivity (Bennett *et al.*, 1962; Tomita & Watanabe, 1973; den Hertog & Jager, 1975), it seems probable that u.v. light is acting on some step in the same sequence of events that occur as a result of purinergic receptor activation. This view is supported by the finding that high concentrations of phentolamine and antazoline, which reduce the inhibitory responses to purinergic nerve stimulation, also reduce the responses to u.v. light. In addition, the 'rebound contractions' following the inhibitory responses to both ATP and u.v. irradiation are blocked by indomethacin, which suggests that both ATP and u.v. light are acting on the same receptors that lead to the synthesis of prostaglandins (see also Needleman, Minkes & Douglas, 1974).

An effect of u.v. light was only demonstrable in the guinea-pig taenia coli and rabbit portal vein where ATP produced relaxation. In the bladder, where ATP produced contraction, and in the ureter, where it has no effect, u.v. light did not evoke a response. The different response of these smooth muscle preparations make it unlikely that u.v. light is acting on nonspecific common pathways, such as a Ca^{2+} channel in the smooth muscle membrane, leading to relaxation, and suggests that it is more likely that u.v. light is acting on some part of the purinergic receptor complex that mediates the inhibitory response. Therefore it is possible that u.v. irradiation may provide a way of investigating the chemistry of inhibitory purinergic receptors (see Burnstock, 1976).

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