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Rise in the intramammary pressure of the ewe after injection of water into the inguinal artery

par J. LABUSSIÈRE, M. C. RUIZ, J. F. COMBAUD

Laboratoire de la Traite, I. N. R. A.,
65, route de St. Brieuc, 35042 Rennes cedex, France.

Summary. The injection of distilled water into the inguinal artery of the anesthetized Manech ewe caused intramammary pressure to rise (fig. 1) ; the deflexion level was higher the larger the volume of water injected (0.5 to 8 ml ; fig. 2) and the shorter the injection time (3.5 to 28 seconds : fig. 3). The pressure increase obtained with 4 ml of water injected in 3.5 seconds had the following characteristics (8 animals, 88 injections) :

— deflexion level ($\triangle$) : $\bar{x} = 2.37$ mmHg $\left(\sqrt{s^2/n} = 0.17\right)$;

— response duration : $\bar{x} = 16.6$ sec $\left(\sqrt{s^2/n} = 1.03\right)$;

— time-course between beginning of injection and onset of intramammary pressure rise : $\bar{x} = 5.87$ sec $\left(\sqrt{s^2/n} = 0.22\right)$.

In these conditions, response level was comparable to that observed with 4 to 50 mIU doses of oxytocin (fig. 1), although the latency time and the duration tended to be shorter with water than with oxytocin. Some studies to interpret the effect of water on intramammary pressure are being carried out, and the results will be published soon.

Introduction.

This communication describes a rise in the intramammary pressure of the anesthetized ewe after injection of distilled water into the inguinal artery.

Material and methods.

We used 15 ewes of the Manech breed which were at a mean lactation stage of 40 days ($\pm$ 15 days) and had a mean daily milk yield of 800 ml ($\pm$ 150 ml). The animals were fasted and not milked for 12 hrs prior to the general anesthesia which began with an intrajugular injection of a mixture of Nesdonal-sodium pentobarbital and atropine (1), followed by inhalation of nitrous protoxide and fluothane after tracheal intubation.

(1) The starter mixture was composed of 1 mg of Nesdonal (Specia), 5 mg of 6 p. 100 sodium pentobarbital (Lathevet) and 40 mg of atropine completed by distilled water up to 50 ml.

A 15-mm incision was made in the inguinal region, and after the mammary gland had been slightly detached, we reached the mammary artery in that area. A catheter (28 cm long, external diameter : 0.8 mm, internal diameter : 0.5 mm ; Venocath 18, Abbott laboratory) with a stylet for piercing the artery was pushed 5 to 7 cm into the artery towards the udder ; it was then attached to the arterial wall with several silk sutures and tunneled under the skin, to come out again on the abdominal wall near the udder.

The ewe was held by a sling in a support. The straps of the sling were fixed so that the udder could hang free. About 2 cm of a second polyethylene catheter (Clay Adam type 190 : internal diameter : 1.19 mm ; external diameter : 1.70) was then inserted into the teat and attached to a Hewlett Packard measurement channel including a type 1280 C pressure gauge placed at about the level of the upper part of the teat, and a model 7754 A recorder equipped with a model 8805 B preamplifier.

The volumes of sterile distilled water injected into the first catheter varied between 0.2 and 8 ml (0.2, 0.5, 1, 2, 4, 8 ml) and the injection times between 3.5 and 28 seconds (3.5, 7, 14, 28 secs). Water temperature was 18 °C.

Changes in intramammary pressure (IMP) were compared to those obtained after inguinal administration of low doses of oxytocin (Syntocynon, Sandoz), diluted in 1 or 2 ml of physiological serum and injected in 3.5 seconds.

Results.

Introducing sterile distilled water into the inguinal artery caused a rise in the intramammary pressure, as shown in figure 1. Table 1 summarizes the principal characteristics of this increase. When the injections were repeated every 80 seconds, the responses of the same animal seemed identical, but mammary sensitivity varied

TABLE 1

Characteristics of intramammary pressure rise after injection of 4 ml of water in 3.5 seconds into the inguinal artery (88 injections, 8 ewes)

	Mean $\bar{x}$	$\sqrt{s^2/n}$ (1)
Deflexion ; Δ level (mmHg) (Δ)	2.37	0.17
Latency time between beginning of injection and onset of deflexion (L)	5.87	0.22
Time needed for the recorder to return to basal pressure (T_1)	55.52	2.33
Time needed for the recorder to return to 0.25 mmHg above basal pressure (T_2)	16.61	1.03

(1) $\sqrt{s^2/n}$ Standard mean error.

among animals. Among the 15 ewes studied, 12 showed a strong, short rise of IMP, while in the other 3 cases, response was weak but lasted longer (ewe N ; fig. 1).

This difference would appear to be related to mammary structure ; small glands with small cisterns responded more strongly, and there was often a correspondance between mammary sensitivity to water and to oxytocin.

When 4 ml of water were injected in 3.5 seconds, the levels of IMP (Δ) were comparable with those obtained with injections of 4 to 10 mIU of oxytocin (sometimes 50 to 80 mIU). However, the latency (5.87 sec) and response (T1 = 1720 ; T2 = 82 secs) times tended to be shorter for water than for oxytocin (fig. 1).

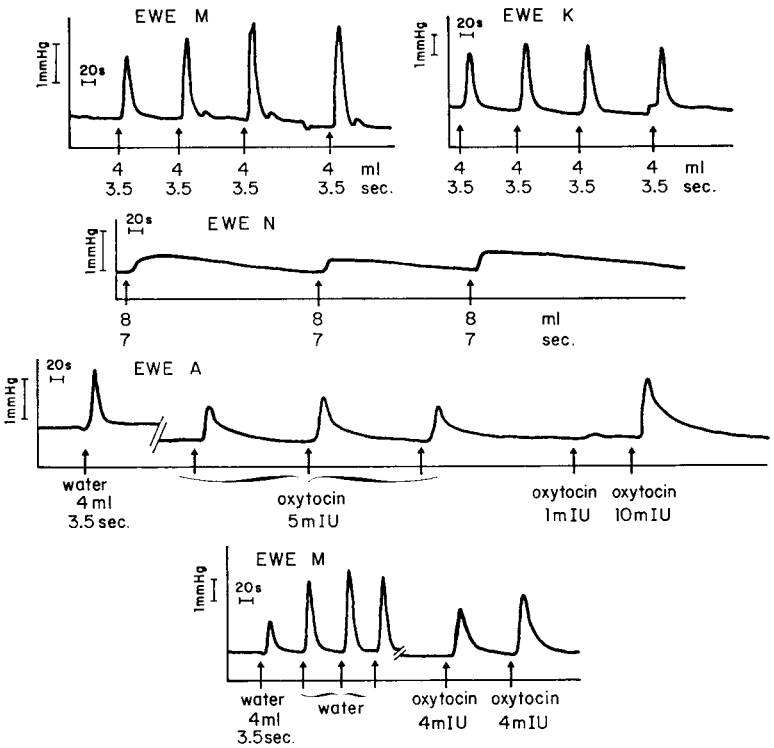

FIG. 1. — *Example of intramammary pressure* (IMP) *increase after the same injections of water, given several times. Comparison with the effect of physiological doses of oxytocin.*

When the injection time remained constant, but the volume of water was increased, the deflexion level (Δ) and duration augmented (fig. 2), while the latency time did not seem to vary. The coefficients of correlation between levels and volumes were high ($+ 0.65 < r < + 0.79$) and very significant, and the relation between the two factors was linear (fig. 2).

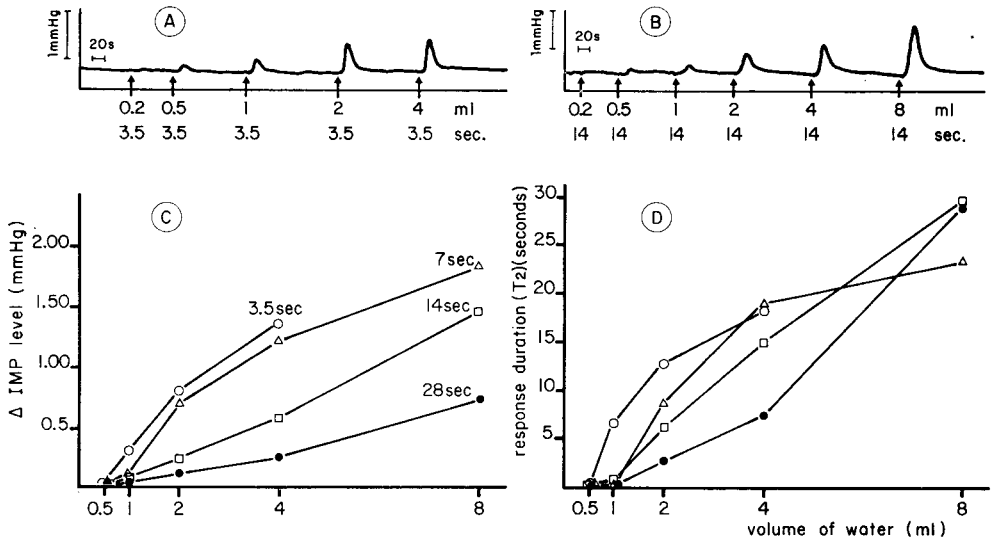

FIG. 2. — *Effect of augmenting the volume of water injected on the characteristics of intramammary pressure* (IMP) *increase* :

a) ewe H (injection time : 3.5 sec) ;

b) ewe C (injection time : 14 sec) ;

c) relation between response volume and level (3 ewes) : for. 3.5. sec, $y = 0.342\ x - 0.094$, $r = + 0.65$; for 7 sec, $y = 0.249\ x - 0.005$, $r = + 0.75$; for 14 sec, $y = 0.184\ x - 0.055$, $r = + 0.79$; for 28 sec $y = 0.107\ x - 0.070$, $r = + 0.72$.

d) relation between response volume and duration (3 ewes) : o-o-o : 3.5 sec ; Δ-Δ-Δ : 7 sec ; □-□-□ : 14 sec ; ●-●-● : 28 sec.

On the other hand, when the volume remained constant and the injection time was prolonged, the deflexion levels (Δ) decreased (fig. 3), while the duration and

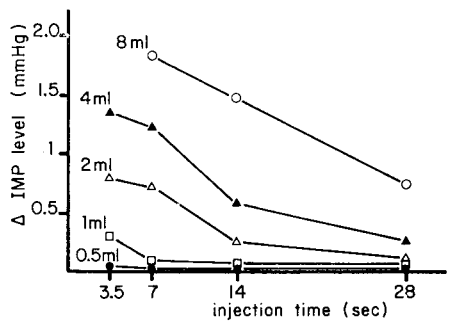

FIG. 3. — *Effect of injection time on the level of intramammary pressure* (IMP) *increase* (3 ewes).

the latency time did not seem to be affected. The response level thus depended closely upon the injection rate : the relation was linear in the range of values studied (between 0.10 and 1.14 ml/sec. ; fig. 4).

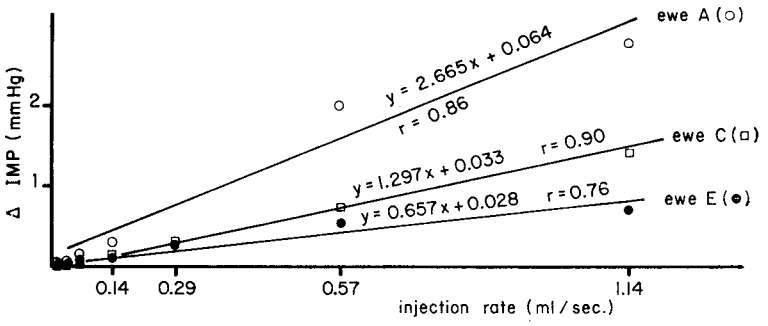

FIG. 4. — *Effect of water injection rate on the level of intramammary pressure* (IMP) *increase* (O) ewe A (□) ewe C (●) ewe E.

Discussion and conclusion.

In the ewe, limited volumes of water, such as 0.5 to 8 ml (or sometimes even 0.2 ml) augmented the IMP when injected into the inguinal artery. To our knowledge, this process has never been reported in the literature, even in other species.

Response levels induced by the water were sometimes elevated since the effects of 4 ml could be compared to those obtained with 4 to 10 mIU of oxytocin, which are considered as relatively high. Indeed, the post-pituitary hormone was, in this case, administered directly into the udder, whereas in the jugular vein, Labussière and Martinet (1970) already obtained physiological response in the ewe with doses lower than 6 mIU.

Deflexion was stronger when a large volume of water was injected in a short time, and thus when the resulting injection rate was high.

The effect of the injection rate has already been shown with oxytocin solutions used in the sow by Whittlestone (1954). That author noted that a dose of 0.06 IU, given in 15 seconds, produced no ejection, while the same dose injected in the same volume in 9 seconds gave a considerable but lower ejection than a 6-second injection. Analogous facts have also been reported in the goat by Martinet and Denamur (1960).

These results show that any intra-inguinal administration of a substance in aqueous solution should be carried out with a volume of less than 0.5 ml since, above that level, IMP increase could be due more to the effect of the water injected than to the substance tested.

In our laboratory we are now trying to interpret the effects of water on intramammary pressure, and the data will be published soon (Labussière, Ruiz and Combaud, 1980).

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Résumé. L'injection d'eau distillée dans l'artère inguinale de brebis Manech anesthésiées, provoque une augmentation de pression intramammaire (fig. 1) dont l'amplitude est d'autant plus forte que le volume injecté est important (0,5 à 8 ml : fig. 2) et que le temps d'injection est court (3,5 à 28 sec. : fig. 3). L'accroissement de pression obtenu avec

4 ml d'eau administrée en 3,5 secondes présente les caractères suivants (8 animaux, 88 injections) :

— Amplitude : $\bar{x} = 2{,}37$ mm Hg $\left(\sqrt{s^2/n} = 0{,}17\right)$;

— Durée de la réponse : $\bar{x} = 16{,}6$ sec $\left(\sqrt{s^2/n} = 1{,}03\right)$;

— Délai entre le début de l'injection et le début de l'augmentation de pression intramammaire : $\bar{x} = 5{,}87$ sec $\left(\sqrt{s^2/n} = 0{,}22\right)$.

Dans ces conditions, l'amplitude des réponses est comparable à celles observées avec des doses de 4 à 50 mUI d'ocytocine (fig. 1) bien que leur latence et leurs durées aient tendance à être plus courte pour l'eau que pour l'ocytocine.

Des essais d'interprétation de l'effet de l'eau sur la pression intramammaire sont actuellement en cours et seront présentés ultérieurement.

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