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Comparison of intradermal and percutaneous testing to histamine, saline and nine allergens in healthy adult cats

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Background – Intradermal testing (IDT) in cats has potential limitations; this has led to an interest in novel testing methods. A pilot study demonstrated that healthy cats produced reliable percutaneous glycerinated (PG) histamine wheals, whereas percutaneously applied glycerosaline did not lead to wheal formation.

Hypothesis/Objective – The purpose of this study was to determine if percutaneously applied aqueous and glycerinated allergens would lead to irritant reactions in healthy cats.

Methods – Percutaneous testing (PCT) with both glycerinated and aqueous allergens and IDT were compared in twelve healthy cats. The lateral thorax was clipped and histamine, saline and nine allergens were tested in rows. Objective and subjective evaluations were performed at 15, 20 and 25 min, and 4 h. Results were evaluated as positive or negative at 15, 20, 25 min and 4 h.

Results – Skin test reactions for intradermal (ID) histamine wheals were larger when compared to PG and percutaneous aqueous (PA) at the immediate reading points ($P < 0.05$) subjectively and objectively; however, PG was not significantly different from ID when compared as either positive (2–4) or negative (0–1). PG histamine and allergen reactions, when present, were larger than equivalent PA reactions. PG and PA allergens did not cause irritant reactions at tested concentrations. *Bassia scoparia* (kochia), when tested at 1000 PNU/mL with IDT, was suspected to be an irritant.

Conclusions and Clinical Importance – Percutaneously (PCT) applied allergens did not cause irritant reactions in healthy cats. PG histamine wheals, although smaller than ID histamine wheals, were easily recognizable and PCT was simple to perform.

Introduction

Feline hypersensitivity disorder (HD), which includes eosinophilic granuloma complex, miliary dermatitis, self-induced alopecia, head and neck pruritus, urticaria, angioedema and allergic asthma, may be caused by flea allergy dermatitis, cutaneous adverse food reactions and hypersensitivity to environmental allergens.[1–3] Environmental allergen-induced HD is diagnosed by clinical signs, history and exclusion of other potentially pruritic skin conditions, such as ectoparasitism and cutaneous adverse food reactions.[3,4]

Following a presumptive diagnosis of HD, identification of significant environmental allergens can be used to create allergen-specific immunotherapy, as well as to practice avoidance.[4,5] Allergens can be identified using allergen-specific IgE serology, epicutaneous patch testing and intradermal testing.[6,7] Intradermal testing (IDT) with aqueous allergens is routinely used to identify significant allergens for allergen-specific immunotherapy in dogs, cats and horses. There is general consensus that this method provides reliable results in the dog and horse with atopic dermatitis.[6,8] Intradermal testing in the cat can provide variable and potentially false negative results.[9,10] This has led to an increased interest in novel methods of reliably identifying significant environmental allergens in the cat.

A pilot study demonstrated that percutaneous testing (PCT) could be performed in sedated healthy cats. That study evaluated histamine, saline and glycerosaline reactions using two different skin picks at 15, 20 and 25 min.[11] The GREER® Pick System (GREER®; Lenoir, NC, USA) produced reliable and well-demarcated wheals with 6 mg/mL glycerinated histamine as a positive control without creating wheals with the negative glycerosaline control. In contrast, the Duotip-test II pick® (Lincoln Diagnostics Inc.; Decatur, IL, USA) glycerinated histamine reactions were small and not significantly different from glycerosaline. Compared to the histamine wheals created by IDT, the histamine wheals made using the GREER® Pick® System were better demarcated, indicating that PCT may be used as an alternative to IDT in the cat.[11]

Our study compared PCT and IDT in healthy cats using nine allergens as well as histamine and saline controls. The primary goal was to determine if percutaneously applied aqueous and glycerinated allergens would create

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irritant reactions in healthy domestic cats using the GREER® Pick® System. We hypothesized that irritant reactions would not occur. Four secondary goals were to (i) confirm the reliability of control wheal formation from the pilot study, (ii) recommend a preferred PCT immediate reading time, (iii) determine if currently used IDT concentrations would cause irritant reactions in healthy cats and (iv) determine if subjective and objective data correlated.

Materials and methods

Cats

Twelve client-owned, adult cats without known or suspected hypersensitivities were enrolled. Cat owners provided informed written consent for their cats' enrolment after reviewing the experimental design. Physical examination was performed to rule out any dermatological or other medical conditions. When available, prior medical records were reviewed to rule out pre-existing conditions that could interfere with test results or preclude sedation. To be included, cats must have been 1 year of age or greater, had no prior or current evidence of dermatological or other medical conditions and could not be currently receiving oral or topical medications other than routine heartworm and ectoparasite control. Heartworm and ectoparasite control were not mandated to be included in the study due to the low prevalence of heartworm disease and ectoparasites in cats in the authors' region. There was an 8 week withdrawal for oral, topical and injectable glucocorticoids; an 8 week withdrawal for oral ciclosporin; and a 4 week withdrawal for topical or oral antihistamines. Exclusion criteria included cats with previously diagnosed with HD, contact hypersensitivity and failure to meet any of the inclusion criteria listed.

Sedation

After physical examination, the cats were sedated with intramuscular dexmedetomidine (Dexdomitor®, Zoetis; Exton, PA, USA) at or below the manufacturer's recommendation based on body weight. After testing was completed, the sedation was reversed with an epaxial muscle injection of atipamezole (Antisedan®, Zoetis) at a volume equal to the dexmedetomidine used before. Cats were fasted for a minimum of 8 h prior to sedation.

Percutaneous and intradermal testing

A rectangle was clipped on the left lateral thorax and a permanent marker was used to numerically mark each of nine rows and dots indicated individual allergens and controls. Testing was performed in triplicate in each cat. The row numbers of percutaneous glycerinated (PG), percutaneous aqueous (PA) and ID 4 test sites were block randomized and the primary investigator (CMG) was blinded to the application sites. Percutaneous testing was performed with the GREER® Pick System®. Percutaneous application of both glycerinated and aqueous allergens were performed by holding the picks at an approximately 45° angle to the skin surface against the direction of hair growth. The picks, each containing 0.0035 ml of allergen or control, were pressed to the skin surface and twisted approximately 90° before removal.[12] A new pick was used for each application of allergen or control.

Intradermal injections were performed with a volume of 0.05 mL of the allergens or controls through a 27 gauge needle. The positive control for PA and ID was 0.0275 mg/mL aqueous histamine (GREER®) and the positive control for PG was 6 mg/mL glycerinated histamine base (10 mg/mL histamine dihydrochloride; GREER®). The negative control for PA and ID was sterile buffered 0.9% saline and the negative control for PG was 50% glycerosaline (GREER®). The nine tested allergens were: *Dermatophagoides farinae,* canine dander, Kentucky blue grass (*Poa pratensis*), Red cedar (*Juniperus virginiana)*, eastern cottonwood (*Populus deltoides)*, common cocklebur (*Xanthium strumarium)*, kochia (*Bassia scoparia)*, *Penicillium* sp. and mosquito. The same manufacturer lot number of each allergen was used throughout the study.

The selected allergens were commonly positive on canine and feline IDT in the authors' region and represented five distinct classes of allergens (house dust mite, dander, pollen, mould and insect). The tested concentrations of aqueous and glycerinated allergens are detailed in Table 1. Glycerinated *D. farinae*, *P. pratensis* and mosquito were either not commercially available or only available for clinicians treating human patients. For these allergens, the concentrated aqueous allergens were diluted 1:1 with 50% glycerin as suggested by the manufacturer (Tracy Burchette, GREER®, personal communication 2014).

Each PG, PA and ID site was evaluated at 15, 20 and 25 min, and approximately 4 h. Reaction grading of wheal size and potential flare (erythematous halo outside the boundary of the wheal), was evaluated subjectively and objectively at 15, 20 and 25 min as described previously.[8,13] Subjective scoring was based on a 0–4 scale, where a 4 reaction was as strong as typical ID histamine and a 0 reaction was similar to most negative controls. Objective measurements were taken to the nearest millimetre by averaging the vertical and horizontal diameter of the wheal and potential flare. At approximately 4 h, reactions were graded subjectively as positive or negative. One cat was excluded from the 4 h evaluation time point due to fractious behaviour that did not allow further evaluation.

Statistical analysis

A repeated measures analysis (PROC Mixed) was used to detect differences between PA, ID and PG data points at 15, 20 and 25 min for subjective and objective data for histamine, saline and allergens. Individual time points were evaluated to determine the preferred reading time for PCT. These three immediate time points were combined into overall immediate time point data and evaluated in a similar way. A repeated measures analysis (PROC Mixed) was also used to detect reaction differences based on skin colour (grey, white or grey/white). An unstructured covariance structure was assumed. Multiple comparisons were made by Tukey's test. *P*-values less than 0.05 were considered significant. A chi-square test was used to compare positive and negative reactions at the 4 h time point; chi-square and Fisher's exact test analyses were performed to compare subjective reactions as either negative (0–1) or positive (2–4) at time points 15, 20 and 25 min. Statistical analyses were performed using SAS v9.2 (Cary, NC, USA).

Results

Cats

All twelve cats met the inclusion and exclusion criteria. They included four spayed females and eight neutered males. The age of the cats ranged from one to 10 years (mean 4.6 years) and weights ranged from 3.2 to 7.6 kg (mean 5.3 kg). Eight of the cats were domestic short hair and one each of the following breeds: domestic medium hair, domestic long hair, Scottish fold and Himalayan. Four cats had white skin, six cats had grey skin and two cats had mixed grey and white skin at the testing site.

Table 1. Testing concentrations of aqueous and glycerinated allergens used in the study

Allergen	*Dermatophagoides farinae*	Canine dander	*Poa pratensis*	*Juniperus virginiana*	*Populus deltoides*	*Xanthium strumarium*	*Bassia scoparia*	*Penicillium* sp.	Mosquito
Aqueous	1:5,000 w/v	1000 PNU/mL	1000 PNU/mL	1000 PNU/mL	1000 PNU/mL	1000 PNU/mL	1000 PNU/mL	1000 PNU/mL	1000 PNU/mL
Glycerinated	1:200 w/v	1:20 w/v	20,000 PNU/mL	1:20 w/v	1:20 w/v	1:20 w/v	1:20 w/v	1:20 w/v	10,000 PNU/mL

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ID versus PG immediate allergen reactions at individual and combined evaluation points

Objective data

Canine dander and *D. farinae* had significantly larger ID wheals overall when compared to PG wheals ($P < 0.05$). *Poa pratensis* and *Penicillium* sp. had statistically significantly larger ID wheals overall ($P < 0.05$) and *P. pratensis* ID wheals were also larger at the 15 min time point when compared to PG wheals ($P < 0.05$). *Bassia scoparia* and mosquito had larger ID wheals overall and at each of the immediate evaluation points ($P < 0.05$; Table 2, Figures S1, S2). There were no significant differences between PG and ID reactions for *J. virginiana*, *P. deltoides* and *X. strumarium* overall, or at individual time points (Figures S3, S4). No flare reactions were noted for any ID or PG allergens.

Subjective data

D. farinae had larger ID wheals overall when compared to PG wheals; however, these differences were not statistically significant at the 20 min time point ($P < 0.05$; Table 2). *Poa pratensis* ID wheals were larger when compared to PG wheals overall and at the 15 min evaluation point ($P < 0.05$). *Penicillium* sp. ID wheals were larger than PG wheals overall, but not at individual evaluation points ($P < 0.05$; Table 2). *Bassia scoparia* and mosquito ID had larger wheals overall and at each of the immediate evaluation points ($P < 0.05$; Table 2). There were no significant differences between PG and ID reactions for *J. virginiana*, *P. deltoides* and *X. strumarium* overall, or at individual time points (Figures S3, S4).

ID versus PG comparison as positive or negative

The data for ID and PG were evaluated at 15, 20 and 25 min as either negative (a subjective score of 0–1) or positive (a subjective score of 2–4) as this most closely mimics current clinical practice for determining significance of reactions.[7,12] The data were evaluated at 4 h in a similar way. There were significantly more positive reactions for ID when compared to PG for *B. scoparia* and mosquito at time points 15, 20 and 25 min ($P < 0.05$). At 4 h, PG histamine had significantly more positive reactions than ID histamine ($P < 0.05$) and were no differences between ID and PG for the nine allergens.

Table 2. Comparison of intradermal (ID) and percutaneous glycerinated (PG) allergens at the 20 min evaluation point

Allergen	Subjective score range 0–4 (mean)	Wheal size range (mean) (cm)
Dermatophagoides farinae (ID)	0–4 (0.39)	0.0–0.9 (0.08)
D. farinae (PG)	0–2 (0.11)	0.0–0.5 (0.03)
Canine dander (ID)	0–2 (0.17)	0.0–0.75 (0.07)
Canine dander (PG)	0–2 (0.14)	0.0–0.45 (0.03)
Poa pratensis (ID)	0–2 (0.17)	0.0–0.5 (0.04)
P. pratensis (PG)	0–1 (0.03)	0.0–0.2 (0.01)
Juniperus virginiana (ID)	0–0 (0)	0.0–0.0 (0.0)
J. virginiana (PG)	0–1 (0.03)	0.0–0.2 (0.03)
Populus deltoides (ID)	0–2 (0.06)	0.0–0.40 (0.01)
P. deltoides (PG)	0–0 (0)	0.0–0.0 (0.0)
Xanthium strumarium (ID)	0–2 (0.06)	0.0–0.4 (0.01)
X. strumarium (PG)	0–0 (0)	0.0–0.0 (0.0)
Bassia scoparia (ID)	0–3 (1.25)*	0.0–0.55 (0.3)*
B. scoparia (PG)	0–2 (0.31)*	0.0–0.4 (0.07)*
Penicillium sp. (ID)	0–2 (0.08)	0.0–0.65 (0.03)
Penicillium sp. (PG)	0–1 (0.03)	0.0–0.25 (0.01)
Mosquito (ID)	0–3 (0.94)*	0.0–0.8 (0.24)*
Mosquito (PG)	0–2 (0.17)*	0.0–0.35 (0.04)*

*indicates significance with $P < 0.05$ with either subjective or objective evaluation between testing methods.

PA immediate allergen reactions at individual and combined evaluation points

Most PA allergen immediate reactions were graded subjectively as 0 (data not shown). Subjectively, PG reactions of the combined immediate reading points were always greater than PA; however, this difference was statistically significant only for canine dander ($P < 0.05$) and *B. scoparia* ($P < 0.05$) overall, there was also a statistically significant difference for *B. scoparia* at the 15 min evaluation point ($P < 0.05$). Objectively, PG reactions were greater than PA for *B. scoparia* overall ($P < 0.05$) and at the 15 min evaluation point ($P < 0.05$; Figures S5, S6). Similar to PG, ID reactions were always greater than PA allergen reactions. No flare reactions were observed for any PA allergens.

Evaluation of controls

Histamine

Wheals from ID histamine were significantly larger than the wheals from PG and PA overall (combined immediate time points) and at each individual immediate time point when evaluated both subjectively and objectively ($P < 0.05$; Table 3, Figure S7). PG histamine wheals were significantly larger than wheals created by PA histamine overall and at each individual time point when evaluated both subjectively and objectively ($P < 0.05$; Table 3). PG histamine wheals were significantly larger at 25 min when compared subjectively to PG wheals at 15 min ($P < 0.05$). PG histamine wheals at the 20 and 25 min evaluation points were not significantly different.

Saline and glycerosaline

Wheals from ID saline were significantly larger both subjectively and objectively when compared to PG glycerosaline wheals overall and at the 15 min evaluation point ($P < 0.05$) and PA saline wheals overall and at the 15 min evaluation point ($P < 0.05$). There was no statistical difference between ID, PG and PA saline wheals when

Table 3. Comparison of intradermal (ID), percutaneous glycerinated (PG) and percutaneous aqueous (PA) histamine and saline at the 20 min evaluation point

Control	Subjective score range 0-4 (mean)	Wheal size range (mean) (cm)
Histamine (ID)	3–4 (3.83)*	0.55–1.15 (0.87)*
Histamine (PG)	1–4 (2.86)*	0.2–1.2 (0.66)*
Histamine (PA)	0–2 (0.60)*	0.0–0.45 (0.15)*
Saline (ID)	0–2 (0.11)	0.0–0.7 (0.04)
Saline (PG)	0–1 (0.03)	0.0–0.25 (0.01)
Saline (PA)	0–0 (0)	0.0–0.0 (0.0)

*indicates significance with $P < 0.05$ with either subjective or objective evaluation between testing methods.

evaluated at the 20 and 25 min evaluation points (Table 3, Figure S8). No flare reactions were observed for histamine, saline or glycerosaline for ID, PA or PG.

Evaluation of reactions based on cat skin colour

There was a significant difference both subjectively and objectively overall for *Penicillium* sp. when comparing white skin to grey or mixed colour skin ($P < 0.05$). Otherwise, there was no difference in PG, PA and ID reactions with the different skin colours.

Correlation of subjective and objective data

Subjective and objective data were compared for correlation with near complete agreement of pooled cat data between ID and PG. There was a single discrepancy of the pooled cat data between ID and PG wheal size for canine dander with the combined immediate time points; it was significant during objective evaluation ($P < 0.05$), but not during subjective evaluation ($P = 0.450$). There was a single discrepancy for the comparison of PA and PG for canine dander for the combined immediate reaction time data, which was significant subjectively ($P < 0.05$) but not objectively ($P = 0.1909$). There were two discrepancies between PA and ID. The first was for *D. farinae* at the 15 min reading point, which was significant subjectively ($P < 0.05$) but not objectively ($P = 0.0503$); the second was for canine dander at the 15 min reading point, which was significant objectively ($P < 0.05$) but not subjectively ($P = 0.124$).

Discussion

The primary goal of this study was to determine if percutaneously applied allergen extracts previously used in the identification of allergen-specific hypersensitivities would create irritant reactions in healthy adult cats. In this study we found that PA and PG allergens did not lead to irritant reactions. PG and ID histamine provided reliable controls in this study, whereas PA histamine did not. Based on the larger wheal size at the 20 and 25 min evaluation points for PG, the 20 min evaluation point is recommended and subjective evaluation can be used. The current IDT concentrations of *B. scoparia* and mosquito may be irritants and these testing concentrations may need to be re-evaluated.

The majority of the percutaneously applied allergen wheals at the 20 min time point were graded as 0–1, which in a clinical setting would be considered insignificant (data not shown for PA at 20 mins). Overall, PA and PG allergens created smaller or similar sized wheals when compared to ID allergen wheals. These data suggest that these nine allergens do not cause irritant reactions in healthy adult cats when applied percutaneously at the tested concentrations. An increase in sample size may have detected additional differences between testing methods.

The allergens chosen were from multiple allergen classes including: mites, dander, grass pollen, weed pollen, tree pollen, mould and insects, to encompass the majority of allergen groups tested on a routine basis. It is speculated that other allergens from these same classes would not create irritant reactions in healthy cats when tested at the manufacturer's suggested concentrations. This speculation is supported by the lack of irritant reactions to 10 mg/mL concentration of house dust mite, storage mite and pollens applied to the inner thigh of healthy adult dogs using pick lancets (Entaco Ltd; Worcestershire, UK).[14] In the same study, 19 of 34 (56%) of the atopic dogs had one or more positive allergen reactions.[14] However, it is not known if the allergens used in that study were glycerinated or aqueous.

Percutaneously applied glycerosaline and aqueous saline did not lead to irritant reactions consistent with the previous studies of cat and human PCT.[11,15] Likewise, a PCT study, albeit in abstract form, reported on a canine model where there were no wheal reactions with glycerosaline when applied to both the lateral thorax and inner thigh.[16] Based on these previous studies and the current study, glycerosaline can be used as a percutaneous negative control in canine and feline patients.

In a previous study, ID histamine wheals were slightly larger in size than percutaneous 6 mg/mL glycerinated histamine wheals, although the latter were noted to be firmer and easier to read.[11] The groups were not compared statistically. In the current study, the PG and ID wheals were compared statistically, with the ID histamine wheals being consistently larger. Similar to the previous study, the PG histamine wheals were well demarcated and easy to evaluate.[11] A canine study also found that percutaneously applied 5 mg/mL histamine created well-demarcated wheals.[14] PA histamine wheals were poorly visible and PA testing with 0.0275 mg/mL aqueous histamine is therefore not recommended.

The PA allergens were lower in concentration compared to PG. PA allergens were the same concentration as the ID allergens, but the volume applied was smaller. Therefore, the combination of low volume and more diluted concentration may have led to the weaker PA wheals when compared to ID and PG wheals. This concentration was chosen for convenience as allergens are already diluted for intradermal testing in this manner. However, it is unclear if the stock concentrated solutions of aqueous histamine and aqueous allergens would produce reliable reactions without causing irritant reactions.

With the exception of *B. scoparia* and mosquito, the majority of ID reactions were graded as 0–1. There were multiple reactions graded as 2–3 for *B. scoparia* and mosquito using IDT. The cause for these positive reactions may include a subclinical hypersensitivity or irritant reaction. Previous studies identified that clinically normal animals may have positive reactions on both intradermal and serum allergen tests, which is why these tests cannot be substituted for a thorough history and clinical signs in the diagnosis of HD.[3,4] As many of the study cats were young to middle-aged, it is possible that these patients may develop HD in the future, making the positive reactions potentially clinically relevant. Another likely explanation is that the currently tested concentration of *B. scoparia* at 1000 PNU/mL is an irritant because 10 of 12 cats had two or greater subjective reactions to this allergen. There have been minimal published data on allergen testing concentrations in the cat, with a previous study evaluating 10 allergens in healthy cats and cats with environmentally induced HD.[10] In that study, *B. scoparia* and mosquito

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were not evaluated. It is likely that this tested concentration is a true irritant or the currently used lot number of *B. scoparia* was more concentrated than previous lot numbers. A previous study has shown that allergen concentrations may vary between batches.[17]

For mosquito, 5 of 12 cats had ID reactions graded as 2–3. Similar to *B. scoparia*, the tested concentration of mosquito may represent an irritant reaction or a more concentrated lot of allergen. Interestingly, four of five cats with a reaction to mosquito had a history of spending time outdoors, whereas the remainder of the cats in the study (7 of 12) did not. This may support the theory that cats with outdoor exposure may be subclinically hypersensitized to mosquito.

The 25 min reading produced larger wheals for PG histamine compared to the 15 min reading point. There was no significant difference between the 20 and 25 min time points. As the 20 min reading points were similar to 25 min time point, the 20 min time point is recommended to reduce the length of sedation in cats as well as technician time. This is similar to previous findings where 20 min was the recommended reading time because larger histamine wheals were produced at 20 and 25 min compared to the 15 min time point.[11] Also, similar to the pilot study there was good to excellent correlation for subjective and objective grading, suggesting that subjective grading can be used for PCT in cats.[11]

Skin colour did not create significant differences in subjective or objective wheal size for the controls or eight allergens in the current study, with only *Penicillium sp* having larger wheals in white-skinned cats. The lack of significant differences with histamine and almost all allergens may be in contrast to what can be seen in human PCT, where darker skin colour PCT are typically more difficult to evaluate subjectively when compared to lighter skin colour PCT wheals (Raweewan Hoontrakoon, personal communication 2014).

Ideally, the same concentration of glycerinated allergens would have been used for all allergens. However, this was not possible as the *D. farinae*, *P. pratensis* and mosquito allergens used in this study were not available. In these cases the manufacturer had recommended a dilution of the concentrated allergen 1:1 with glycerin. As the goal of this study was to determine if PG allergens would lead to irritant reactions, we did not attempt to determine the optimal PG allergen concentration for future testing.

In conclusion, the selected percutaneous aqueous and percutaneous glycerinated allergens did not cause irritant reactions in healthy adult cats. Percutaneously applied glycerinated histamine and glycerosaline provide reliable controls. Subjective grading is reliable for further feline PCT studies and the 20 min reading point is recommended. Additional studies will be needed to determine the ideal testing concentrations for both percutaneous glycerinated and percutaneous aqueous allergens. In addition, ideal IDT concentrations may need to be evaluated for mosquito and *B. scoparia*. Future goals include comparing complete percutaneous glycerinated and ID allergen tests in cats with environmental hypersensitivities and the response to allergen-specific immunotherapy based on PCT.

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Supporting Information

Additional Supporting Information may be found in the online version of this article.

Figure S1. Comparison of mosquito objective wheal size in cm for intradermal (ID), percutaneous aqueous (PA)

and percutaneous glycerinated (PG) testing. The 36 data points for each group represent the data performed in triplicate in the 12 study cats at the 20 min reading point. Means are shown as solid lines.

Figure S2. Comparison of mosquito subjective wheal size (0–4) for intradermal (ID), percutaneous aqueous (PA) and percutaneous glycerinated (PG) testing. The 36 data points for each group represent the data performed in triplicate in the 12 study cats at the 20 min reading point. Means are shown as solid lines.

Figure S3. Comparison of *P. deltoides* objective wheal size in cm for intradermal (ID), percutaneous aqueous (PA) and percutaneous glycerinated (PG) testing. The 36 data points for each group represent the data performed in triplicate in the 12 study cats at the 20 min reading point. Means are shown as solid lines.

Figure S4. Comparison of *P. deltoides* subjective wheal size (0–4) for intradermal (ID), percutaneous aqueous (PA) and percutaneous glycerinated (PG) testing. The 36 data points for each group represent the data performed in triplicate in the 12 study cats at the 20 min reading point. Means are shown as solid lines.

Figure S5. Comparison of *B. scoparia* objective wheal size in cm for intradermal (ID), percutaneous aqueous (PA) and percutaneous glycerinated (PG) testing. The 36 data points for each group represent the data performed in triplicate in the 12 study cats at the 20 min reading point. Means are shown as solid lines.

Figure S6. Comparison of *B. scoparia* subjective wheal size (0–4) for intradermal (ID), percutaneous aqueous (PA) and percutaneous glycerinated (PG) testing. The 36 data points for each group represent the data performed in triplicate in the 12 study cats at the 20 min reading point. Means are shown as solid lines.

Figure S7. Comparison of histamine wheal size in cm for intradermal (ID), percutaneous aqueous (PA) and percutaneous glycerinated (PG) testing. The 36 data points for each group represent the data performed in triplicate in the 12 study cats at the 20 min reading point. Means are shown as solid lines.

Figure S8. Comparison of saline wheal size in cm for intradermal (ID), percutaneous aqueous (PA) and percutaneous glycerinated (PG) testing. The 36 data points for each group represent the data performed in triplicate in the 12 study cats at the 20 min reading point. Means are shown as solid lines.

Résumé

Contexte – Les tests intradermiques (IDT) chez le chat ont des limites potentielles; ce qui mène à s'intéresser à de nouvelles méthodes diagnostiques. Une étude pilote a démontré que les chats sains produisent de façon fiable des papules après application percutanée d'histamine glycérinée (PG) tandis que la glycérosaline seule, appliquée en percutané ne mène pas à la formation de papules.

Hypothèses/Objectifs – Le but de cette étude était de déterminer si l'application d'allergènes aqueux ou glycérinés peut mener à des réactions irritantes chez les chats sains.

Méthodes – Les tests percutanés (PCT) à l'aide d'allergènes aqueux et glycérinés et des IDT ont été comparés cher douze chats sains. Le thorax latéral a été tondu et l'histamine, l'eau saline et neufs allergènes ont été testés en ligne. Des évaluations objectives et subjectives ont été réalisées à 15, 20 et 25 min et 4h. Les résultats ont été évalués comme positif ou négatif à 15, 20, 25 min et 4h.

Résultats – Les réactions des tests cutanés pour les papules d'histamine intradermiques (ID) étaient plus larges que les PG et PA (percutaneous aqueous) aux points de lecture immédiats ($P < 0.05$) subjectivement et objectivement; cependant, PG n'était pas significativement différent des IDT quand comparés en tant que positif (2-4) ou négatif (0-1). Les réactions aux allergènes et à l'histamine PG, lorsque présentes, étaient plus larges que les réactions correspondantes à PA. Les allergènes PG et PA n'entrainaient pas de réactions irritantes aux concentrations testées. Basia scoparia (kochia), lorsque testé à 1000 PNU/mL avec IDT était suspecté irritant.

Conclusions et importance clinique – Les allergènes appliqués en percutané ne causaient pas de réaction irritante chez les chats sains. Les papules d'histamine PG bien que plus petites que les papules d'histamine ID étaient facilement identifiables et PCT étaient de réalisation aisée.

Resumen

Introducción – las pruebas intradérmicas en gatos (IDT) tienen potenciales limitaciones; esto ha llevado a un interés en desarrollar nuevos métodos diagnósticos. Un estudio piloto demuestra que gatos sanos producen ampollas percutáneas fiables con histamina glicerinada (PG), mientras que la aplicación cutánea de salino glicerinado no lleva a la formación de dichas ampollas.

Hipótesis/Objetivos – el propósito de este estudio fue determinar si la aplicación percutánea de alergenos en solución acuosa y en solución glicerinada puede producir reacciones irritantes en gatos sanos

Métodos – las pruebas percutáneas (PCT) para ambos alergenos glicerinados y acuosos e IDT se compararon en 12 gatos sanos. Se rasuró la zona lateral del tórax y se probaron en hileras histamina, salino y nueve alergenos. Se desarrollaron evaluaciones objetivas y subjetivas a los 15, 20, 25 minutos y cuatro horas. Los resultados fueron evaluados como positivos o negativos a los 15, 20, 25 minutos y cuatro horas.

Resultados – las pruebas de reacciones en la piel para las ampollas producidas por histamina tras aplicación intradérmica fueron más grandes cuando se compararon con PG y solución percutánea acuosa (PA) en los puntos de lectura inmediata ($P < 0,05$) subjetivamente y objetivamente; sin embargo, PG no fue

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significativa diferente de IDT cuando se compararon como positivo (2-4) o negativo (0-1). Las reacciones de PG histamina y alergenos, cuando estuvieron presentes, fueron más grandes que las equivalentes reacciones de PA. Los alérgenos en PG y PA no causaron reacciones irritantes a las concentraciones probadas. *Bassia scoparia* (kochia), cuando fue probada a 100PNU/mL mediante IDT, fue sospechosa de ser irritante.
Conclusión e importancia clínica – los alérgenos aplicados por vía percutánea no causaron reacciones irritantes en gatos sanos. Las ampollas producidas por histamina PG, si bien eran más pequeñas que las ampollas producidas por ID, fueron más fácilmente reconocibles y PCT es más sencilla de aplicar.

Zusammenfassung

Hintergrund – Der Intradermatest (IDT) bei Katzen weist möglicherweise Limitierungen auf; das hat dazu geführt, dass Interesse an neuen Testmethoden entstand. Eine Pilotstudie zeigte gesunde Katzen, die verlässliche perkutane glyzerinierte (PG) Histaminreaktionen produzierten, während perkutan applizierte glyzerinierte Kochsalzlösung zu keiner Quaddelbildung führte.
Hypothese/Ziele – Das Ziel dieser Studie war es zu untersuchen, ob perkutan applizierte wässrige und glyzerinierte Allergene zu irritierenden Reaktionen bei gesunden Katzen führen würden.
Methoden – Bei zwölf gesunden Katzen wurden perkutane Tests (PCT) mit sowohl glyzerinierten wie auch wässrigen Allergenen und IDT verglichen. Der laterale Thorax wurde geschoren und Histamin, Kochsalzlösung und neun Allergene in Reihen getestet. Es wurden objektive und subjektive Evaluierungen nach 15, 20 und 25 Minuten und nach 4h durchgeführt. Die Ergebnisse wurden nach 15, 20, 25 Minuten und nach 4h als positiv oder negativ beurteilt.
Ergebnisse – Die Hauttestreaktionen der intradermalen (ID) Histaminquaddeln waren sowohl subjektiv als auch objektiv bei den unmittelbaren Beurteilungszeitpunkten (P<0,05)stärker im Vergleich zu den PG und perkutanen wässrigen (PA).; PG war jedoch nicht signifikant verschieden vom IDT, wenn sie entweder als positiv (2-4) oder negativ (0-1) beurteilt wurden. PG Histamin- und Allergenreaktionen waren, wenn sie vorhanden waren, größer als die entsprechenden PA Reaktionen. PG und PA Allergene verursachten bei den getesteten Konzentrationen keine irritierenden Reaktionen. PG und PA Allergene verursachten bei den untersuchten Testkonzentrationen keine irritierenden Reaktionen. Bassia scoparia (kochia) wurde bei einer Konzentration von 1000 PNU/mL mittels IDT als irritierend verdächtigt.
Schlussfolgerung und klinische Bedeutung – Perkutan applizierte Allergene verursachten bei gesunden Katzen keine irritierenden Reaktionen. PG Histamin Quaddeln waren zwar kleiner wie die ID Histaminquaddeln, waren aber einfach erkennbar und PCT war einfach in der Durchführung.

要約

背景 — ネコにおける皮内試験(IDT)は潜在的な限界が存在するため、それは新規の試験方法への関心を集めている。予備試験では、健康なネコは確実に経皮膚グリセリン(PG)処理ヒスタミンが膨疹を形成したのに対し、経皮的に塗布したグリセリン生理食塩水では膨疹の形成がみられなかったことを示していた。
仮説/目的 — この研究の目的は、経皮的に塗布した水溶性およびグリセリン処理アレルゲンは健康なネコにおいて炎症反応を引き起こすかどうかを決定することである。
方法 — グリセリン処理および水溶性アレルゲンの両方を用いた経皮試験(PCT)およびIDTを12頭の健康なネコで比較した。胸部側面を毛刈りし、ヒスタミン、生理食塩水、9種類のアレルゲンを1列に並べて試験を行った。主観的および客観的な評価を15、20、25分後および4時間後に行った。15、20、25分および4時間後に、結果を陽性または、陰性として評価した。
結果 — 皮内(ID)へのヒスタミンによる膨疹に対する皮膚検査の反応は、検査直後の測定時では、主観的および客観的にPGや経皮水溶性(PA)と比較して大きかった。しかし、陽性(2–4)か陰性(0–1)かで比較した時、PGとIDTの間に有意な差はなかった。PGヒスタミンおよびPGアレルゲン反応は、認められた場合は、同等のPAよりも大きな膨疹であった。試験に用いた濃度において、PGおよびPAアレルゲンでは炎症反応は生じなかった。ホウキギ(kochia)は1000 PNU/mL の濃度でIDTを行った時、炎症を生じることが疑われた。
結論および臨床的な重要性 — 経皮的に塗布したアレルゲンは健康なネコでは炎症反応は起こさなかった。PGヒスタミンによる膨疹はIDヒスタミンによる膨疹よりは小さいものの、容易に認識でき、PCTは簡単に実施できた。

摘要

背景 — 猫皮内实验(IDT)存在一定局限性;这引起了人们寻找新检测方法的兴趣。一个试点试验显示健康猫产生可靠的透皮甘油盐酸(PG)组胺风团,而透皮给予甘油盐水不会导致风团。
假设/目的 — 本次研究目的为确定健康猫透皮给予水和甘油盐酸过敏原是否会导致刺激反应。
方法 — 给12只健康猫使用甘油酸盐和水溶过敏原进行透皮试验(PCT)和IDT进行对比。胸侧剃毛,使用组胺、盐水和九种过敏原检测,列成一排。在操作后15、20、25分钟和4小时进行主观和客观评估。15、20、25分钟和4小时结果被判断为阳性和阴性。
结果 — 对比主观和客观判读PG和透皮水(PA)结果(P< 0.05),皮内注射(ID)组胺风团更大;然而,PG与IDT相比没有显著不同,无论是阳性结果(2-4)还是阴性结果(0-1)。本次试验用浓度PG和PA过敏原不会导致刺激反应。扫帚草(地肤属)IDT1000 PNU/mL,疑似有刺激反应。
总结与临床意义 — 健康猫透皮给予过敏原不会导致刺激反应。PG组胺产生风团,尽管比ID组胺风团小,但依然可清晰辨认,且PCT操作简单。

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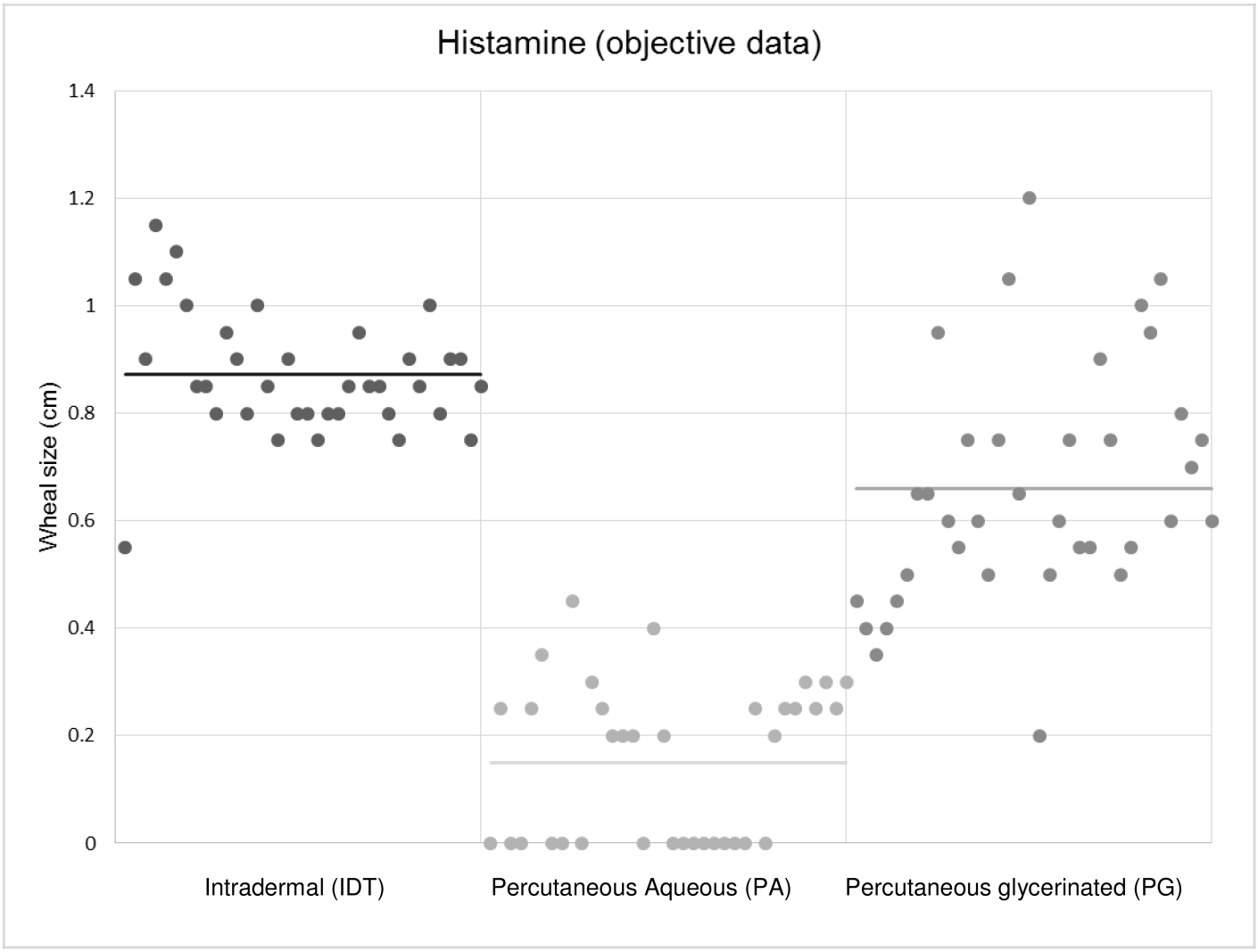
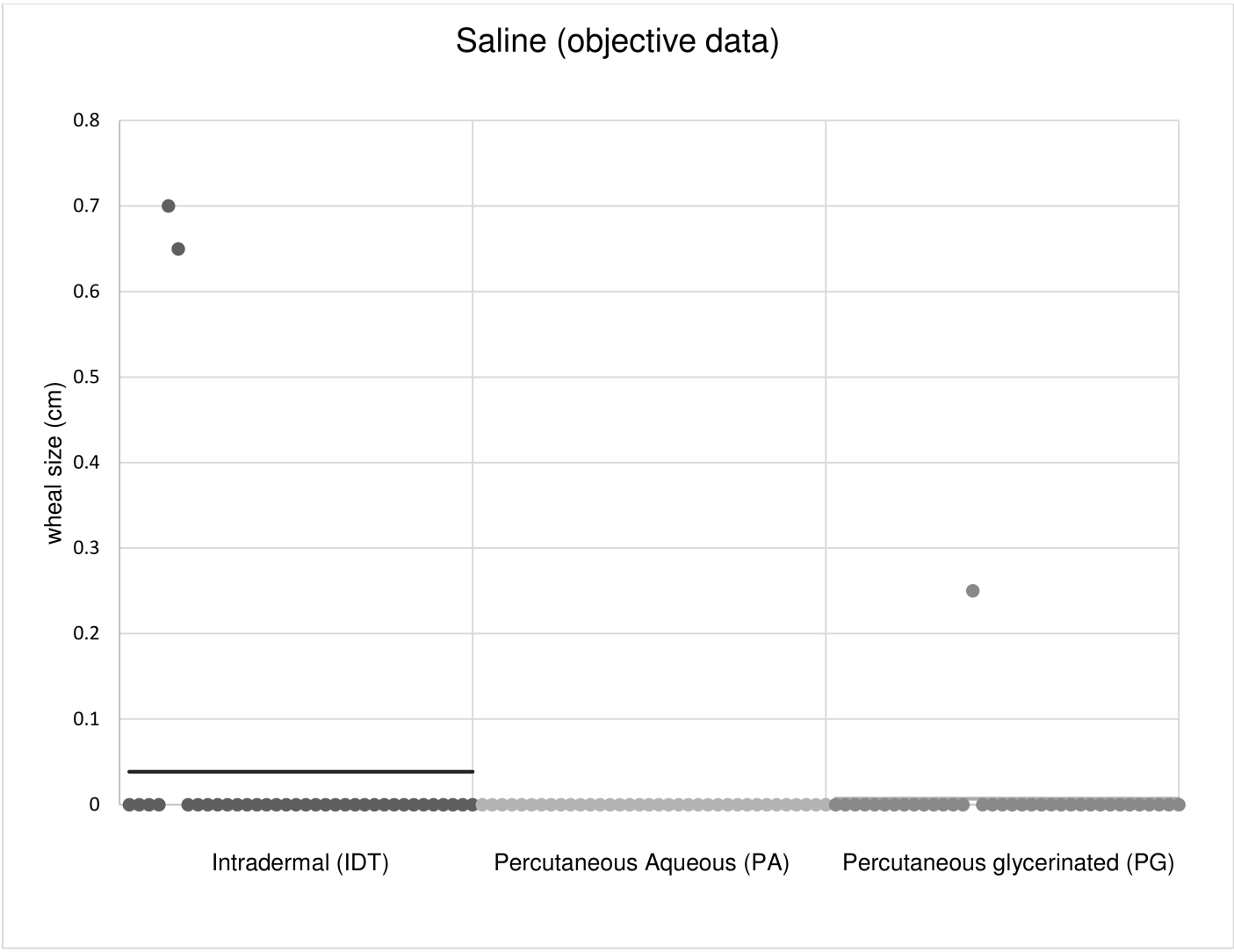
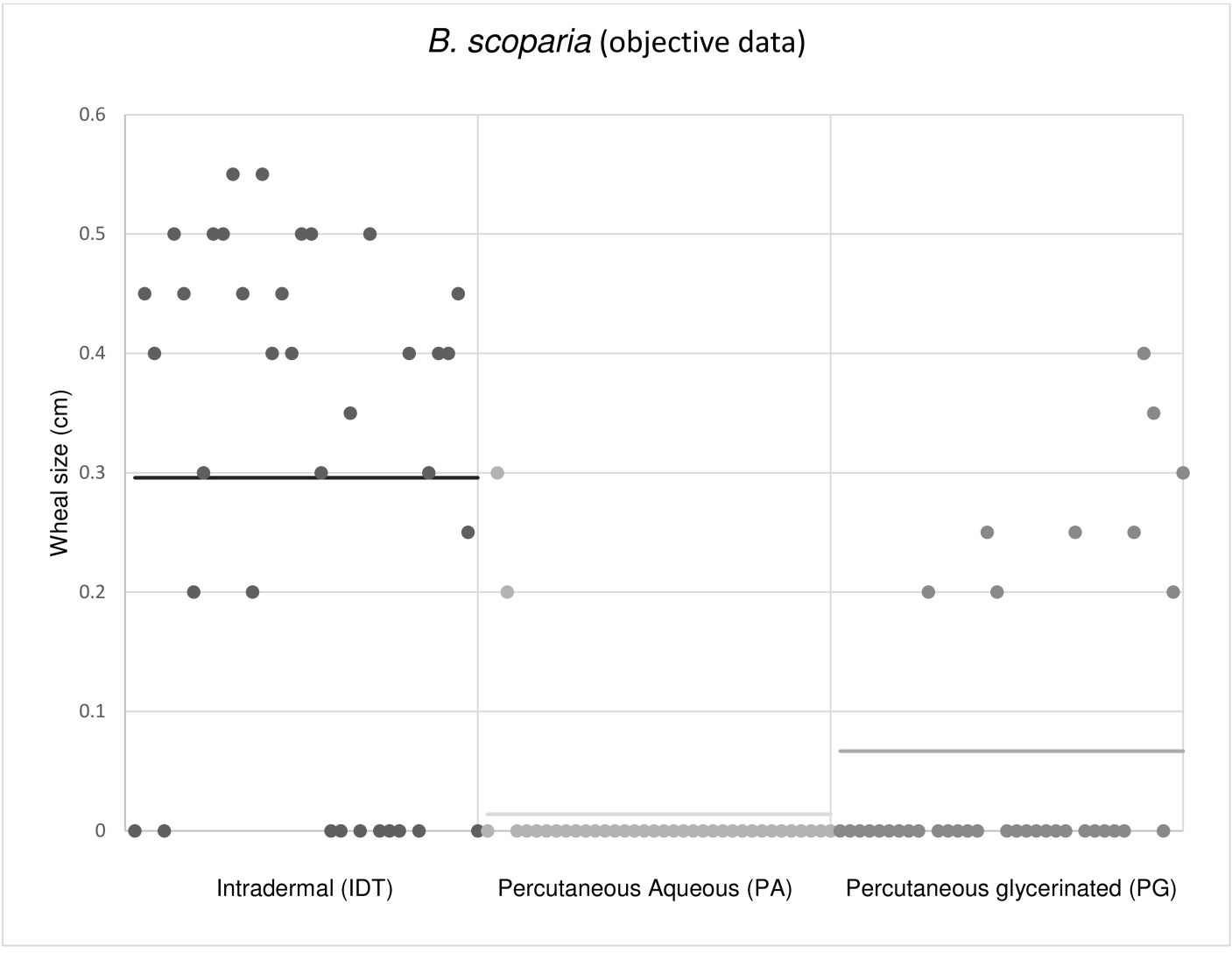
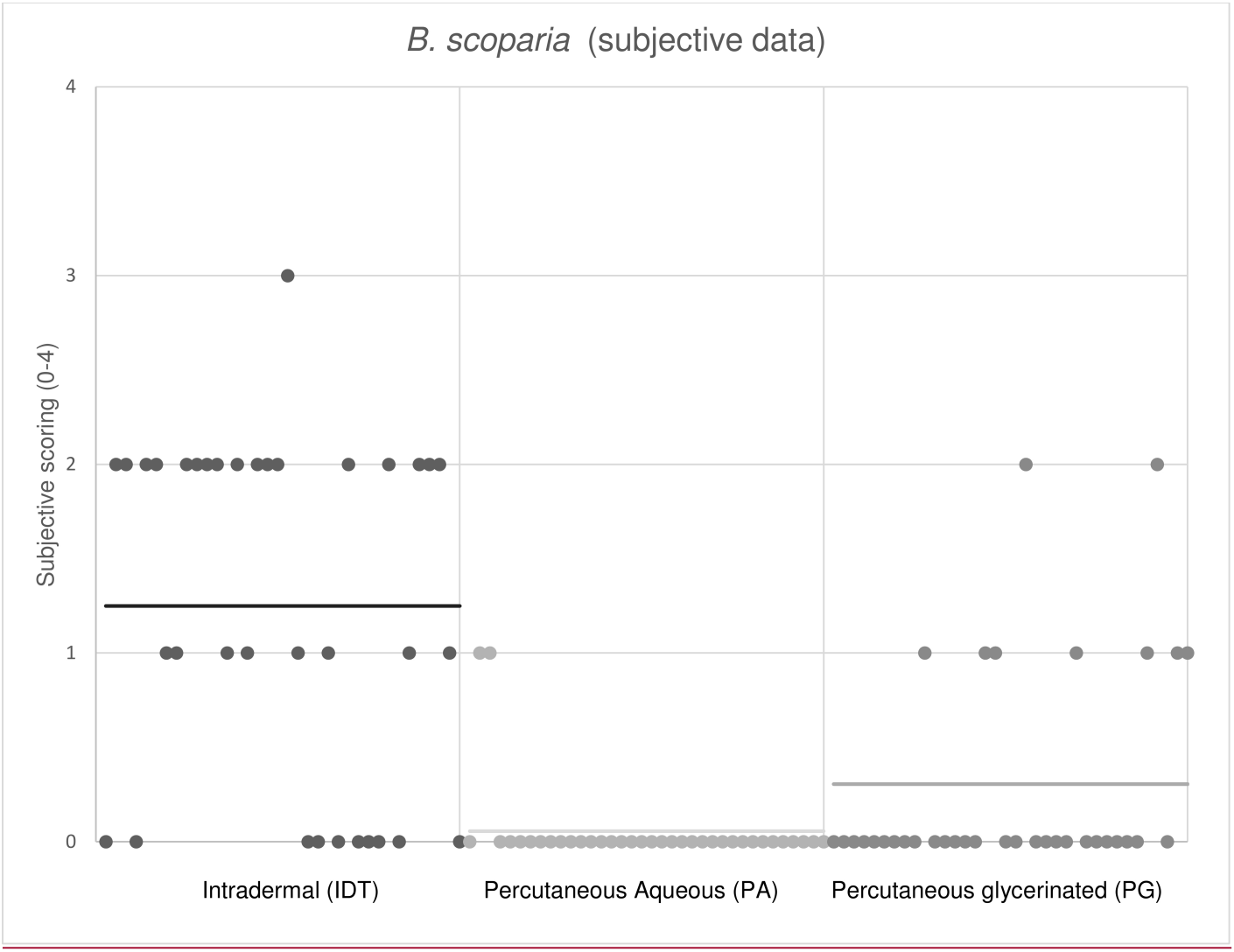
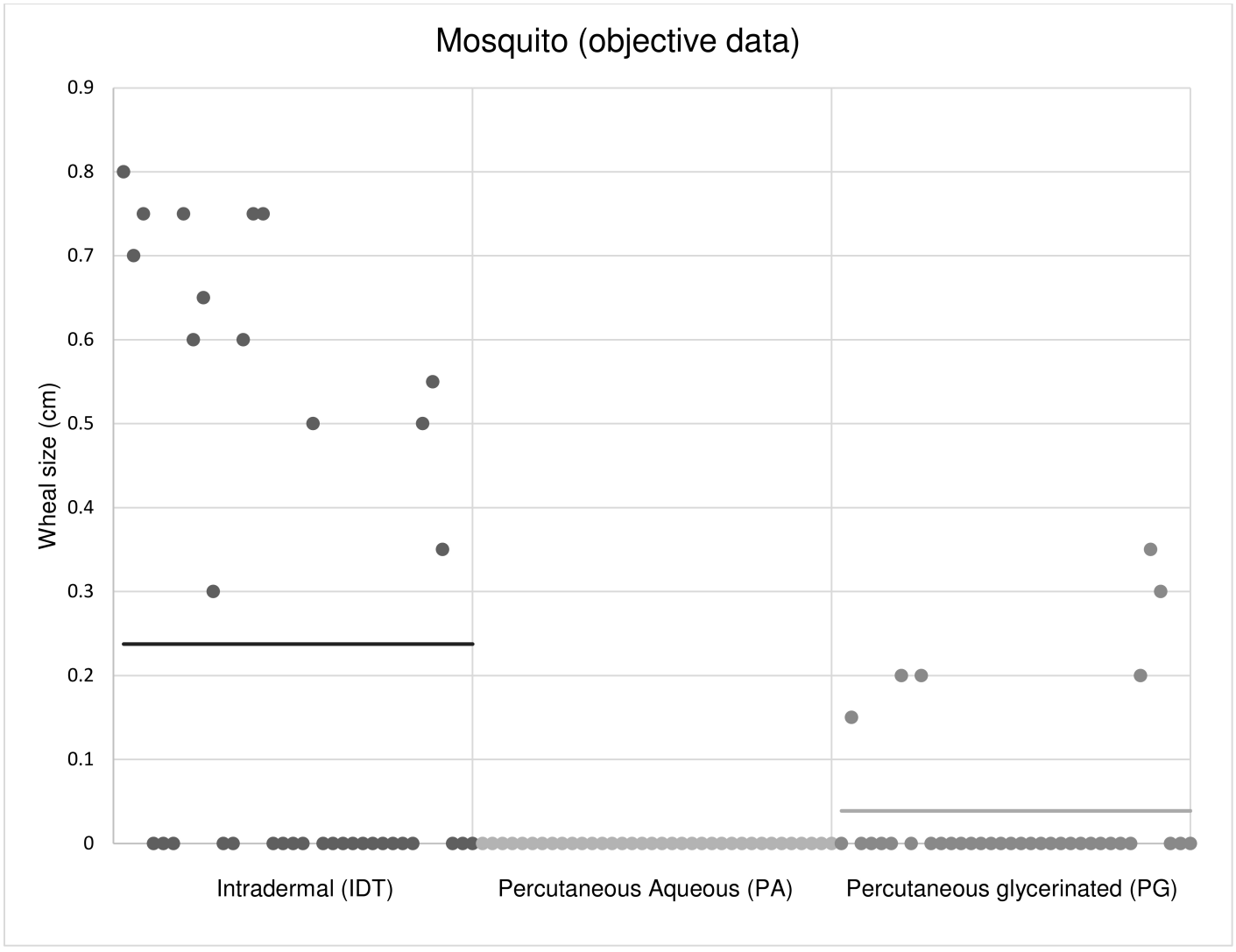
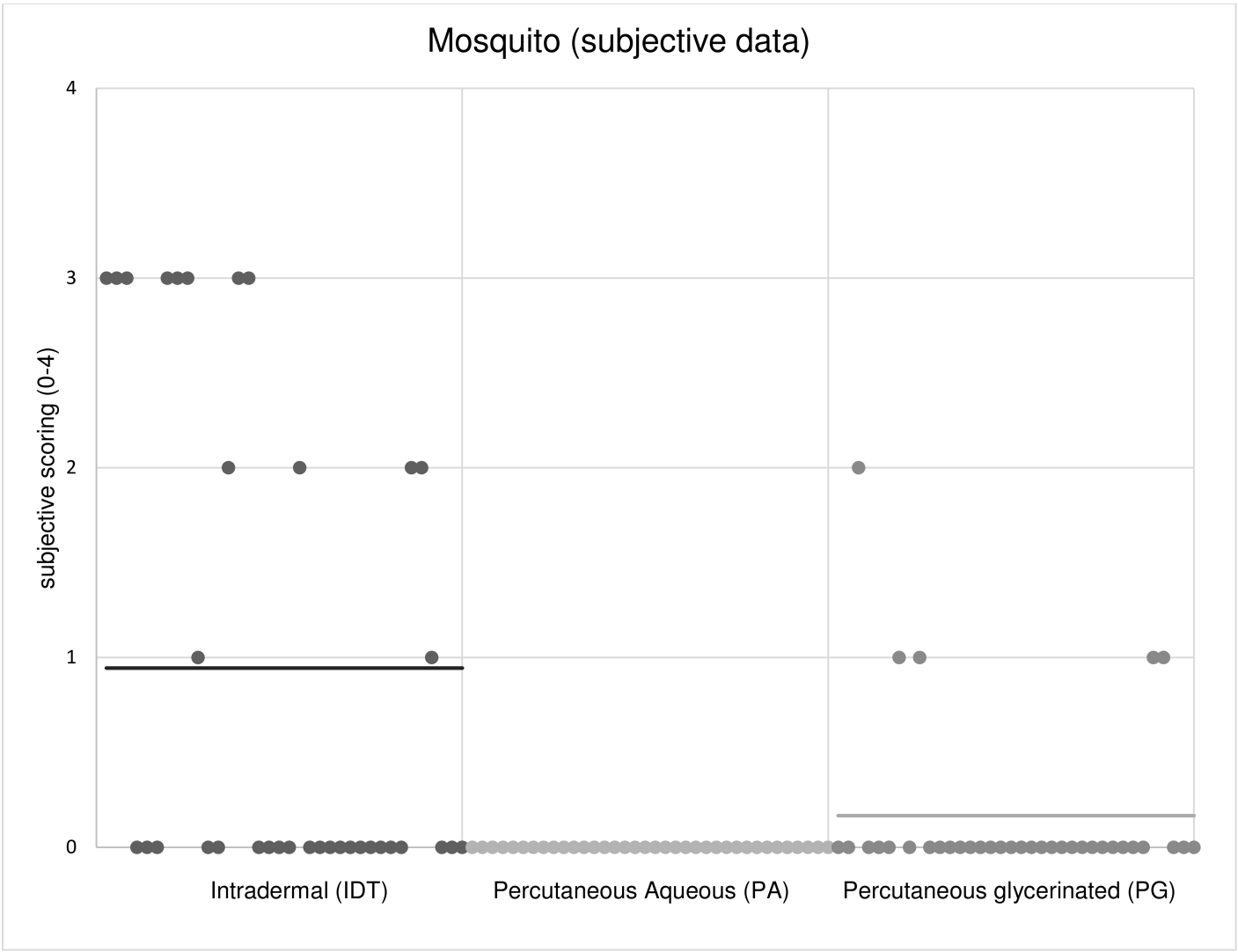

Histamine (objective data)
Wheal size (cm)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Intradermal (IDT)
Percutaneous Aqueous (PA)
Percutaneous glycerinated (PG)

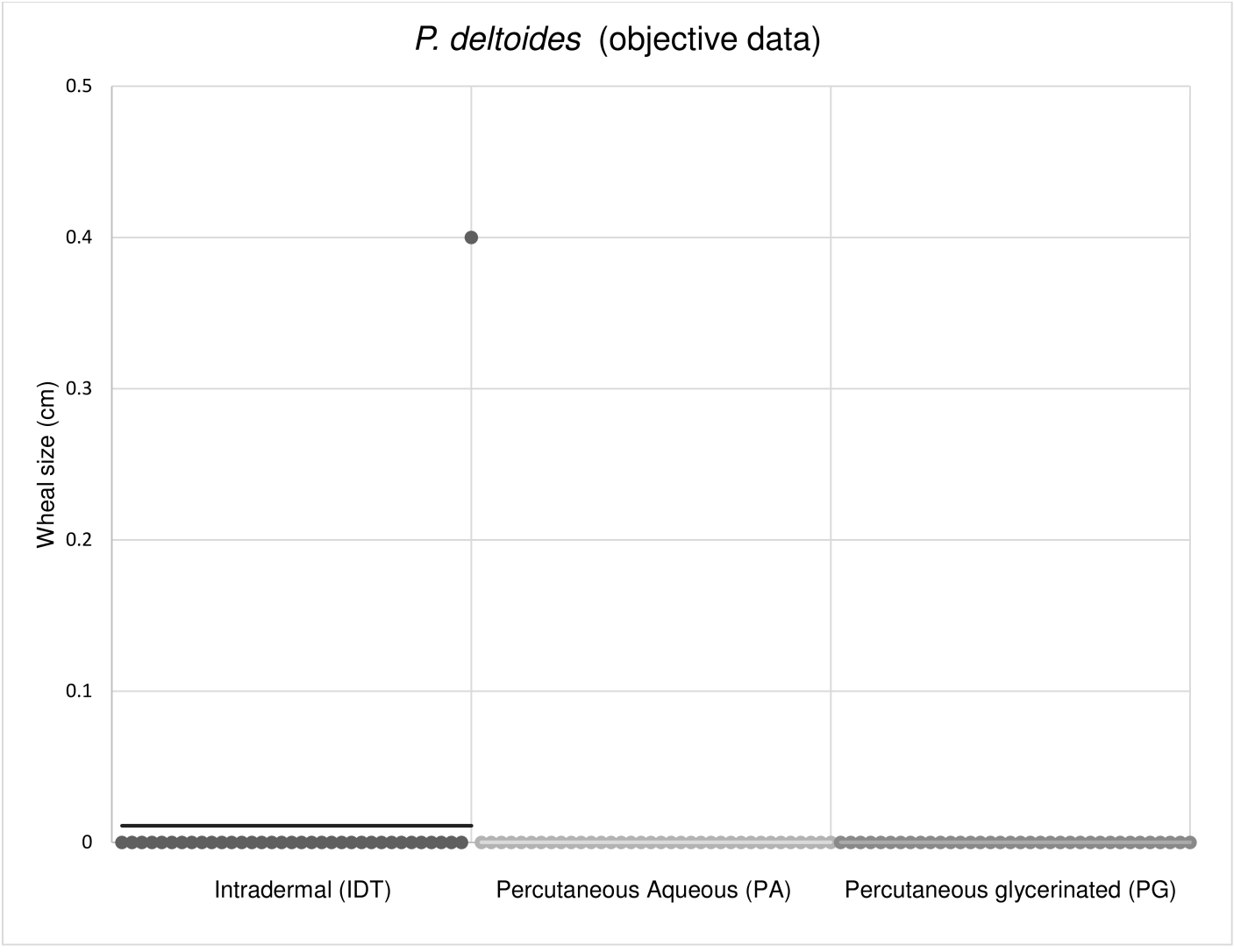

Saline (objective data)
wheal size (cm)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Intradermal (IDT)
Percutaneous Aqueous (PA)
Percutaneous glycerinated (PG)

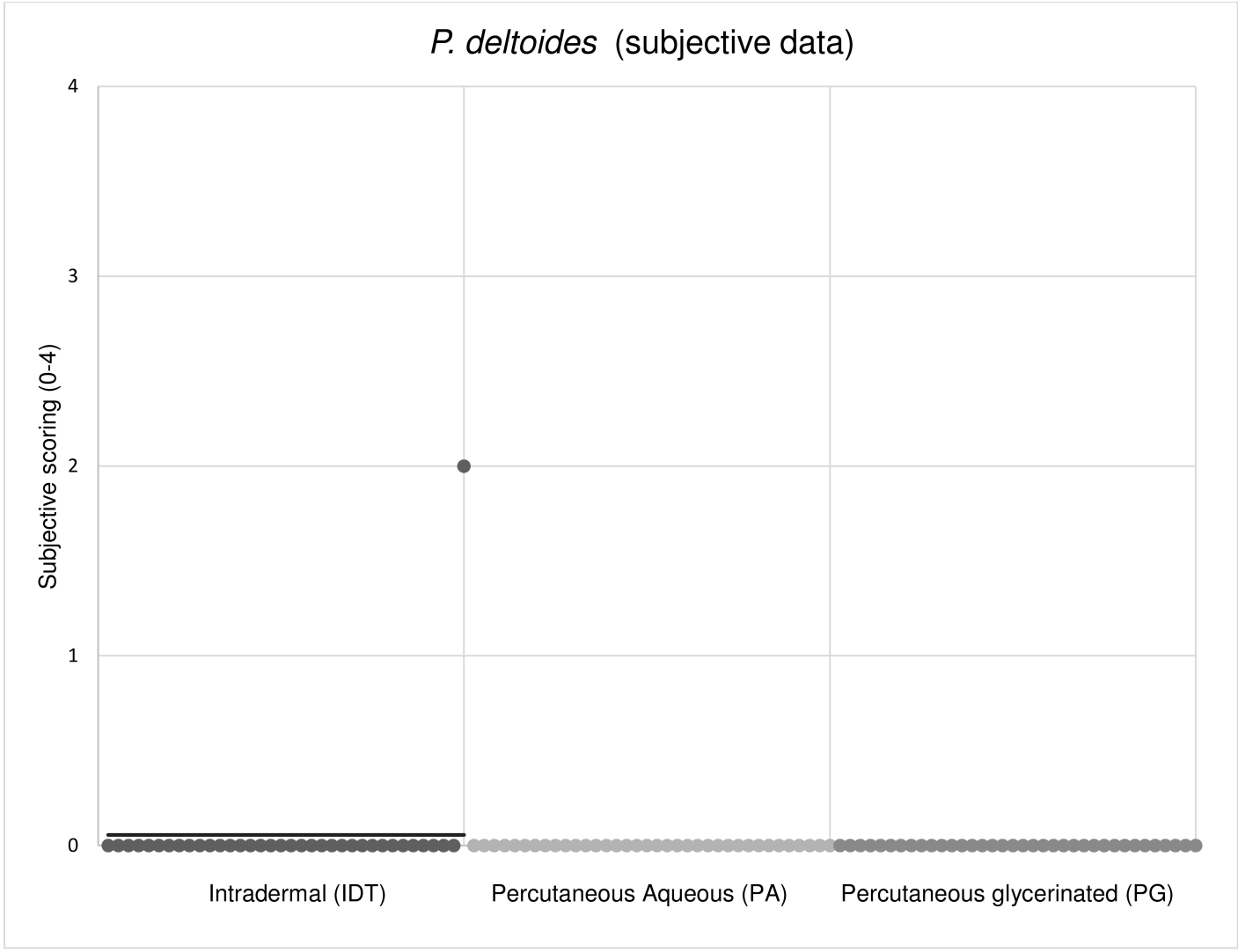

B. scoparia (objective data)
Wheal size (cm)
0.6
0.5
0.4
0.3
0.2
0.1
0
Intradermal (IDT)
Percutaneous Aqueous (PA)
Percutaneous glycerinated (PG)


B. scoparia (subjective data)
Subjective scoring (0-4)
4
3
2
1
0
Intradermal (IDT)
Percutaneous Aqueous (PA)
Percutaneous glycerinated (PG)


Mosquito (objective data)
Wheal size (cm)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Intradermal (IDT)
Percutaneous Aqueous (PA)
Percutaneous glycerinated (PG)


Mosquito (subjective data)
subjective scoring (0-4)
4
3
2
1
0
Intradermal (IDT)
Percutaneous Aqueous (PA)
Percutaneous glycerinated (PG)


P. deltoides (objective data)
0.5
0.4
0.3
0.2
0.1
0
Wheal size (cm)
Intradermal (IDT)
Percutaneous Aqueous (PA)
Percutaneous glycerinated (PG)


P. deltoides (subjective data)
Subjective scoring (0-4)
4
3
2
1
0
Intradermal (IDT)
Percutaneous Aqueous (PA)
Percutaneous glycerinated (PG)