S1: Supplementary Text 1: Quantifying compliance using one versus two regions

This supplementary text contrasts two approaches for calculating bladder compliance. To illustrate these two approaches, the same data set for pressure versus infused volume are used (Case 1). Methodologies for this experiment are described in the main text in Methods F.

Approach 1- Single compliance value for entire pressure volume curve

The International Continence Society (ICS) defines bladder compliance as the ratio of the change in bladder volume ΔV to the change in detrusor pressure ΔP during cystometry [1]. See also (*Werneburg and Stoffel,2021 [2]).* The detrusor pressure is obtained by subtracting the pressure on the outside of the bladder (called the abdominal pressure) from the pressure in the bladder due to both active and passive contributions. The abdominal pressure is typically estimated by using the rectal pressure. Compliance is most often expressed in mL/cm H_20.

The ICS recommends the following two points be used in calculating the change in pressure during cystometry:

1. **Initial Compliance Measurement Point**: The detrusor pressure at the initiation of bladder filling and the corresponding bladder volume.
2. **Final Compliance Measurement Point**: The detrusor pressure and volume at maximum cytometric capacity. This latter point is taken as the pressure and volume just before the start of detrusor contraction with associated decrease in volume due to leakage.

For illustration, we applied this definition to our ex vivo cystometry (filling) experiments, Fig. S1(A). The **initial compliance point** is specified as the point at the beginning of the filling experiment (after pressure rise for the start of the experiment, Fig. S2). The **final compliance point** was specified as the terminal point in the volume-pressure curve, Fig. S2. In this approach, the bladder compliance is represented as a single value equal to the inverse of the slope of the line joining these two points. The exact position of this point is not critical as the example is meant to illustrate that a single compliance value is used in this approach that does not provide information about the two distinct regions (toe and high pressure).

Approach 2: Distinct compliance values for toe and high pressure regimes

As described in the main text, an alternative to estimating the compliance using a single line is to calculate distinct compliances for the toe and high pressure regimes, Fig.S1(A). In our calculations, pressure-volume data were transformed into volume-pressure data so the compliance could be obtained directly on these curves S1(B,C), rather than taking the inverse of the slope. Briefly, we obtain compliance values for these two regions using the following steps (see also, Methods F).

Determination of the Beginning of the Transition Regime (V_{t1}, P_{t1})

An iterative linear fitting procedure was applied to progressively increasing data subsets, starting from the lowest volume values. The process was terminated when the deviation from linearity exceeded 2.5% of the maximum volume within the fitted range. The corresponding volume at this threshold was defined as Vt_1, with the associated pressure denoted as Pt_1.

Determine the end of the transition Regime (V_{t2}, P_{t2})

The volume at the end of the transition regime (coincident with the beginning of the high pressure regime) is denoted as V_{t2}, which was similarly defined relative to a linear fit to the high pressure data. The transition regime was thus defined within the volume range $V \in [V_{t1}, V_{t2}]$, with the corresponding pressure range $[P_{t1}, P_{t2}]$.

Computation of Compliance

Compliance values for the toe and high-pressure regimes were defined as the slope of the respective linear fits with corresponding R^2 values given in Table, Fig. S1(B,C).

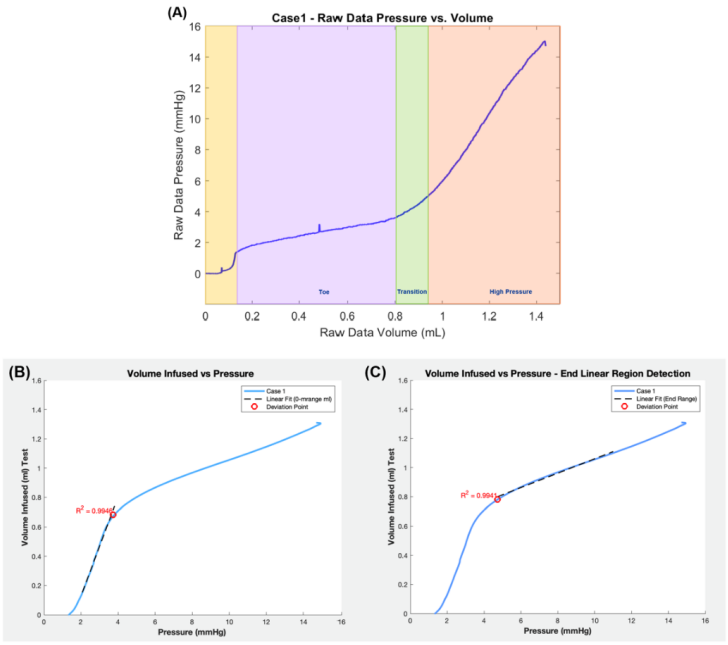

Fig. S1 Application of Approach 2 to obtain distinct compliance values in the toe and high-pressure regions. In (A), the pressure versus volume data is shown. The toe region lies in the purple region and the high pressure region lies in the orange region. In (B),(C), linear fits are obtained for the toe and high pressure regions in the corresponding volume versus pressure curves.

Application of both methods to filling data from Case 1

To contrast these approaches, both were applied to the same data set from Case 1, Fig. S2. The results are shown in Table S1. In the first approach, the compliance is the inverse of the slope of a line joining two points and denoted as C. In the second approach, the initial (toe region) and final (high pressure) compliances are calculated, Fig. S2, and denoted respectively as C_i and C_f. Results are summarized in Table S1 and compliance values are presented both as ml/mmHg and ml/mmH_2O. As can be seen in Fig. S2, by providing distinct values for the toe and high pressure regimes, the response in the early filling can be quantified separately from that in later filling. The linear fit to each of these regimes is captured well using as linear fit as can be seen in the R^2 values for the fits, Table S1. One reason this is important is that the physical mechanisms responsible for these differences are expected to be different. Moreover, the length of the toe regime provides information about the response of the bladder during the low pressure filling stage. In particular, it provides the quantity of urine that can be infused into the bladder with relatively low change in pressure.

Table S1. Results for compliance values using two approaches

Approach	Compliance (ml/mm Hg)	Compliance (ml/cm H_20)	R^2 value compliance
Approach 1: Single compliance: Line joining two points	C = 0.10	C = 0.074	-----
Approach 2: Distinct toe and high pressure compliances: Best linear fit in two regions	Ci = 0.35	Ci = 0.26	0.9946
	C_f= 0.05	C_f= 0.037	0.9941

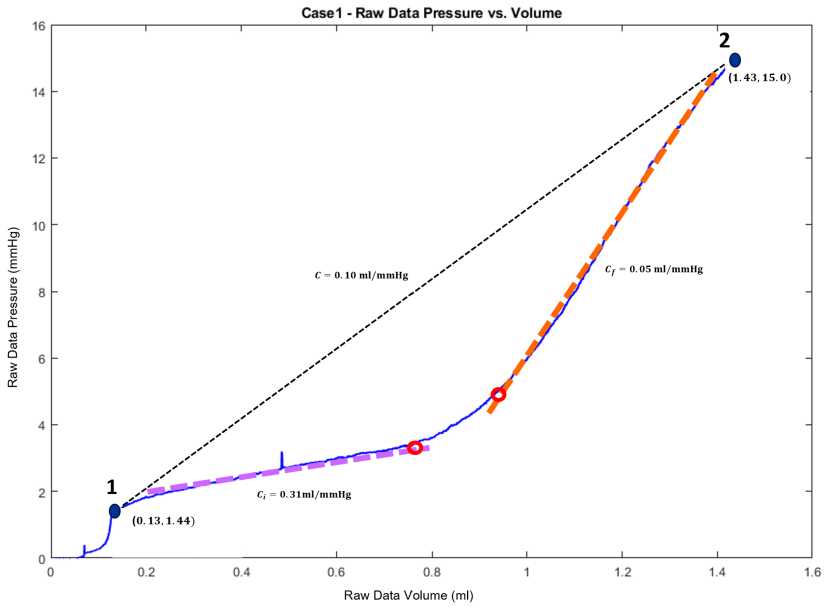

Figure S2: Two approaches for calculating compliance are illustrated using data from Case 1. Approach 1 (clinical): Since compliance (C) based on a line connecting initial and final pressure–volume depicted by black dashed line. Approach 2: Distinct toe and high-pressure compliances (C_i and C_f)– based on linear fits in these two regions, depicted by purple and orange dashed lines.

[1] P. Abrams, L. Cardozo, M. Fall, D. Griffiths, P. Rosier, U. Ulmsten, P. Van Kerrebroeck, A. Victor, A. Wein, The standardisation of terminology in lower urinary tract function: Report from the standardisation sub-committee of the International Continence Society, American Journal of Obstetrics and Gynecology, 2002, 37-49.

[2] G.T. Werneburg, J.T. Stoffel, Bladder Compliance: How We Define It and Why It Is Important, Urol Clin North Am 51(2) (2024) 209-220.