Supplementary material

to

The Phthalic Selenoanhydride Decreases Rat Blood Pressure and Tension of Isolated Mesenteric, Femoral and Renal Arteries

Peter Balis [1,*], Andrea Berenyiova [1], Anton Misak [2], Marian Grman [2], Zuzana Rostakova [3], Iveta Waczulikova [4], Sona Cacanyiova [1], Enrique Domínguez-Álvarez [5] and Karol Ondrias [2]

1 Institute of Normal and Pathological Physiology, Centre of Experimental Medicine, Slovak Academy of Sciences, 841 04 Bratislava, Slovakia; andrea.berenyiova@savba.sk (A.B.); sona.cacanyiova@savba.sk (S.C.)
2 Institute of Clinical and Translational Research, Biomedical Research Center, Slovak Academy of Sciences, 845 05 Bratislava, Slovakia; anton.misak@savba.sk (A.M.); marian.grman@savba.sk (M.G.); karol@ondrias.sk (K.O.)
3 Institute of Measurement Science, Slovak Academy of Sciences, Dubravska cesta 9, 841 04 Bratislava, Slovakia; zuzana.rostakova@savba.sk
4 Faculty of Mathematics, Physics and Informatics, Comenius University, Mlynska dolina F1, 842 48 Bratislava, Slovakia; iveta.waczulikova@fmph.uniba.sk
5 Instituto de Química Orgánica General (IQOG), Consejo Superior de Investigaciones Científicas CSIC , Juan de la Cierva 3, 28006 Madrid, Spain; e.dominguez-alvarez@iqog.csic.es
* Correspondence: peter.balis@savba.sk

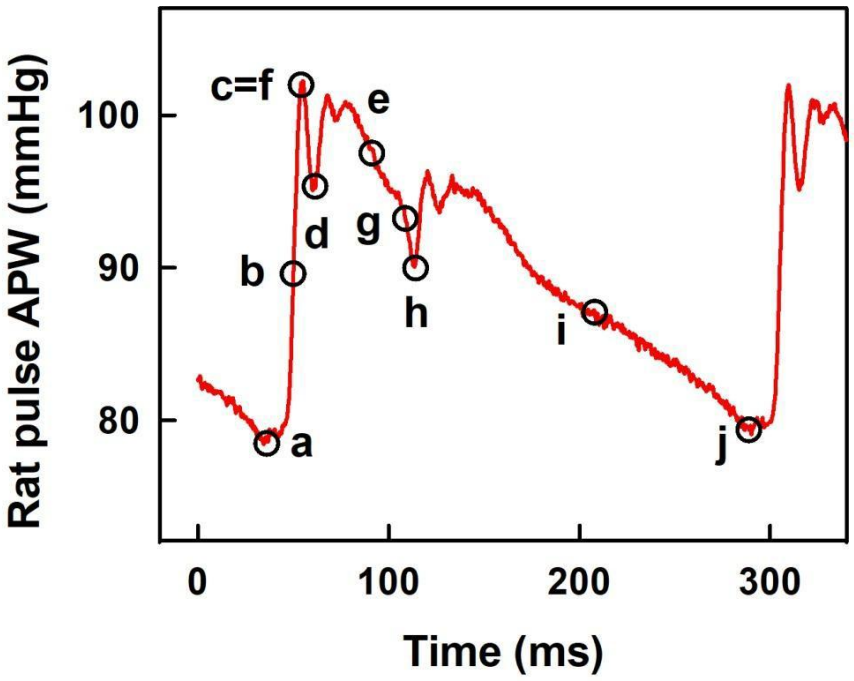


Figure S1. The left common carotid artery pulse waveform (APW) in the anesthetized rat. Control APW with marked ten points **a** - **j** (black circles).

Description of 35 APW parameters (APW-Ps) from APW.

Ten points **a - j** (in bold letters) are from Figure S1 and they mark the values of BP and time that are used to define (calculate) specific APW-Ps

(a) Systolic blood pressure in mmHg; point **c** or **f, point with maximal mmHg**.

(b) Heart rate in min^{-1}; 60 / (**j** – **a**); (**j** – **a**) represents time interval between **a** and **j**, **a** and **j** are two reference points to diastolic BP value.

(c) Systolic area in mmHg s; integral BP of **a** to **h**; **h** refers to BP at the dicrotic notch (dicrotic BP).

(d) dP/dt_{max} in mmHg ms^{-1}; maximum derivative at the point **b**; P is BP in mmHg.

(e) dP/dt_{max} relative level; relative level (RL) of point **b**; (**b** – **a**) / (**c** (or **f**) – **a**) in mmHg/mmHg (dimensionless).

(f) dP/dt_d in mmHg ms^{-1}; negative derivative at the point **i**; the point **i** is the BP in the middle of the time interval between **h** and **j**.

(g) dP/dt_d relative level, relative level of point **i**; (**i** – **a**) / (**c** (or **f**) – **a**) in mmHg/mmHg (dimensionless).

(h) dP/dt_d – dP/dt_{max} in s; time interval between **b** and **i**, dP/dt_d – dP/dt_{max} = (**i** – **b**).

(i) dP/dt_d – dP/dt_{min} in s; time interval between **g** and **i**, dP/dt_d – dP/dt_{min} = (**i** – **g**); dP/dt_{min} is maximum negative derivative at the point **g**.

(j) Diastolic blood pressure in mmHg; the point **a** or **j.**

(k) Pulse BP in mmHg; (**c** – **a**) or (**f** – **a**).

(l) Diastolic area in mmHg s; integral BP of **h** to **j**.

(m) dP/dt_{min} in mmHg ms^{-1}; dP/dt_{min} is maximum negative derivative at the point **g**.

(n) dP/dt_{min} relative level, relative level of point **g**; (**g** – **a**) / (**c** (or **f**) – **a**) in mmHg/mmHg (dimensionless).

(o) dP/dt_{min} delay in s; delay in s of point **g**; (**g** – **a**) time interval between **a** and **g**.

(p) dP/dt_d delay in s; delay in s of point **i**; (**i** – **a**) time interval between **a** and **i**.

(q) dP/dt_d – dP/dt_{max} in mmHg; (**i** – **b**) BP difference between **b** and **i**.

(r) dP/dt_d – dP/dt_{min} in mmHg; (**i** – **g**) BP difference between **g** and **i**.

(aa) Systolic blood pressure in mmHg; point **c** or **f**. Plot (aa) is the same as (a).

(bb) Anacrotic notch in mmHg; BP at the point **d**.

(cc) Anacrotic notch relative level; relative level of point **d**; (**d** – **a**) / (**c** (or **f**) – **a**) in mmHg/mmHg (dimensionless).

(dd) Anacrotic notch delay in ms; delay in ms of point **d**; (**d** – **a**) time interval between **a** and **d**.

(ee) Anacrotic notch relative delay; relative delay (RD) of point **d**; (**d** – **a**) / (**j** – **a**) in ms/ms (dimensionless)

(ff) [Dicrotic notch (DiN) in s] – [Anacrotic notch (AnN) in s] in s; (**h** – **d**) time interval between **d** and **h**.

(gg) [(DiN – AnN) in s] / [dP/dt_{min} in mmHg μs^{-1}] in s/mmHg μs^{-1}; (**h** – **d**) / **g**.

(hh) [(DiN – AnN) in s] / [dP/dt_{max} in mmHg μs^{-1}] in s/mmHg μs^{-1}; (**h** – **d**) / **b**.

(ii) [AnN in ms] – [1Max (point **c** or the 1st. maximum) in ms] in ms; (**d** – **c**) time interval between **c** and **d**.

(jj) Augmentation index relative; (**f** – **c**) / (**f** – **a**) in mmHg/mmHg (dimensionless)**.

(kk) Dicrotic notch in mmHg; BP at the point **h**.

(ll) Dicrotic notch relative level; relative level of point **h**; (**h** – **a**) / (**c** (or **f**) – **a**) in mmHg/mmHg (dimensionless).

(mm) Dicrotic notch delay in ms, delay in ms of point **h**; (**h** – **a**).time interval between **a** and **h**.

(nn) Dicrotic notch relative delay; relative delay of point **h**; (**h** – **a**) / (**j** – **a**); in ms/ms (dimensionless)

(oo) [DiN in mmHg] – [AnN in mmHg] in mmHg; (**h** – **d**) BP difference between **d** and **h**;

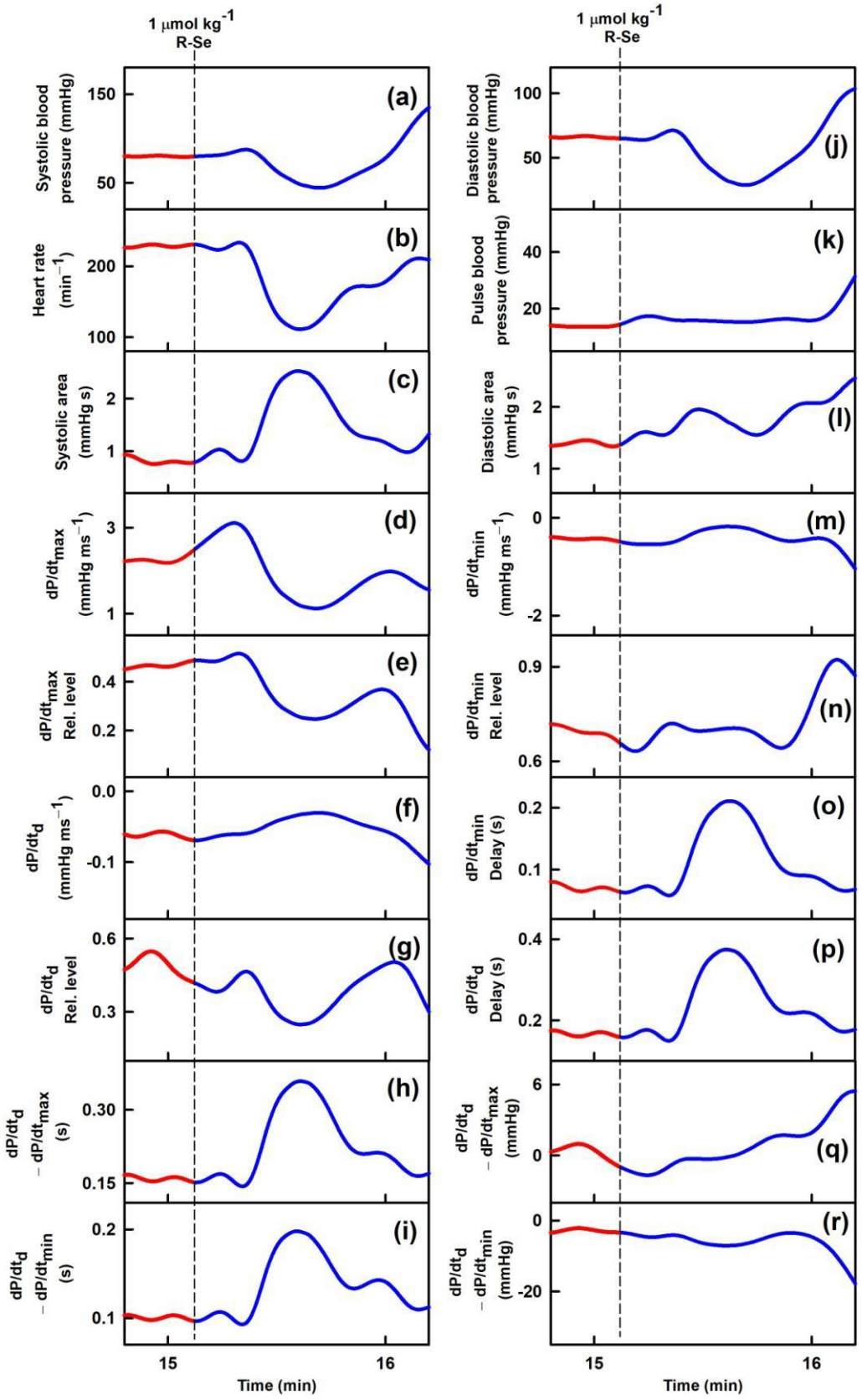
(pp) [(DiN – AnN) in mmHg] / [dP/dt_{min} in mmHg ms^{-1}] in mmHg/mmHg ms^{-1}; (**h** – **d**) / **g**;

(qq) [(DiN – AnN) in mmHg] / [dP/dt_{max} in mmHg ms^{-1}] in mmHg/mmHg ms^{-1}; (**h** – **d**) / **b**.

(rr) [AnN in mmHg] – [1Max (point **c** or the 1st. maximum) in mmHg] in mmHg; (**d** – **c**) BP difference between **c** and **d**.

*Units in plots (gg), (hh), (pp) and (qq) are informative only.

The plot of augmentation index relative (jj**) was not possible to determine in cases when the highest point at APW (Figure S1A) was "c" and not "f" and it was set to zero [1,2]


1 μmol kg-1
R-Se
Systolic blood pressure (mmHg)
150
50
(a)
Heart rate (min−1)
200
100
(b)
Systolic area (mmHg s)
2
1
(c)
dP/dtmax (mmHg ms−1)
3
1
(d)
dP/dtmax Rel. level
0.4
0.2
(e)
dP/dtd (mmHg ms−1)
0.0
-0.1
(f)
dP/dtd Rel. level
0.6
0.3
(g)
dP/dtd − dP/dtmax (s)
0.30
0.15
(h)
dP/dtd − dP/dtmin (s)
0.2
0.1
(i)
15
16
Time (min)
1 μmol kg-1
R-Se
Diastolic blood pressure (mmHg)
100
50
(j)
Pulse blood pressure (mmHg)
40
20
(k)
Diastolic area (mmHg s)
2
1
(l)
dP/dtmin (mmHg ms−1)
0
-2
(m)
dP/dtmin Rel. level
0.9
0.6
(n)
dP/dtmin Delay (s)
0.2
0.1
(o)
dP/dtd Delay (s)
0.4
0.2
(p)
dP/dtd − dP/dtmax (mmHg)
6
0
(q)
dP/dtd − dP/dtmin (mmHg)
0
-20
(r)
15
16
Time (min)

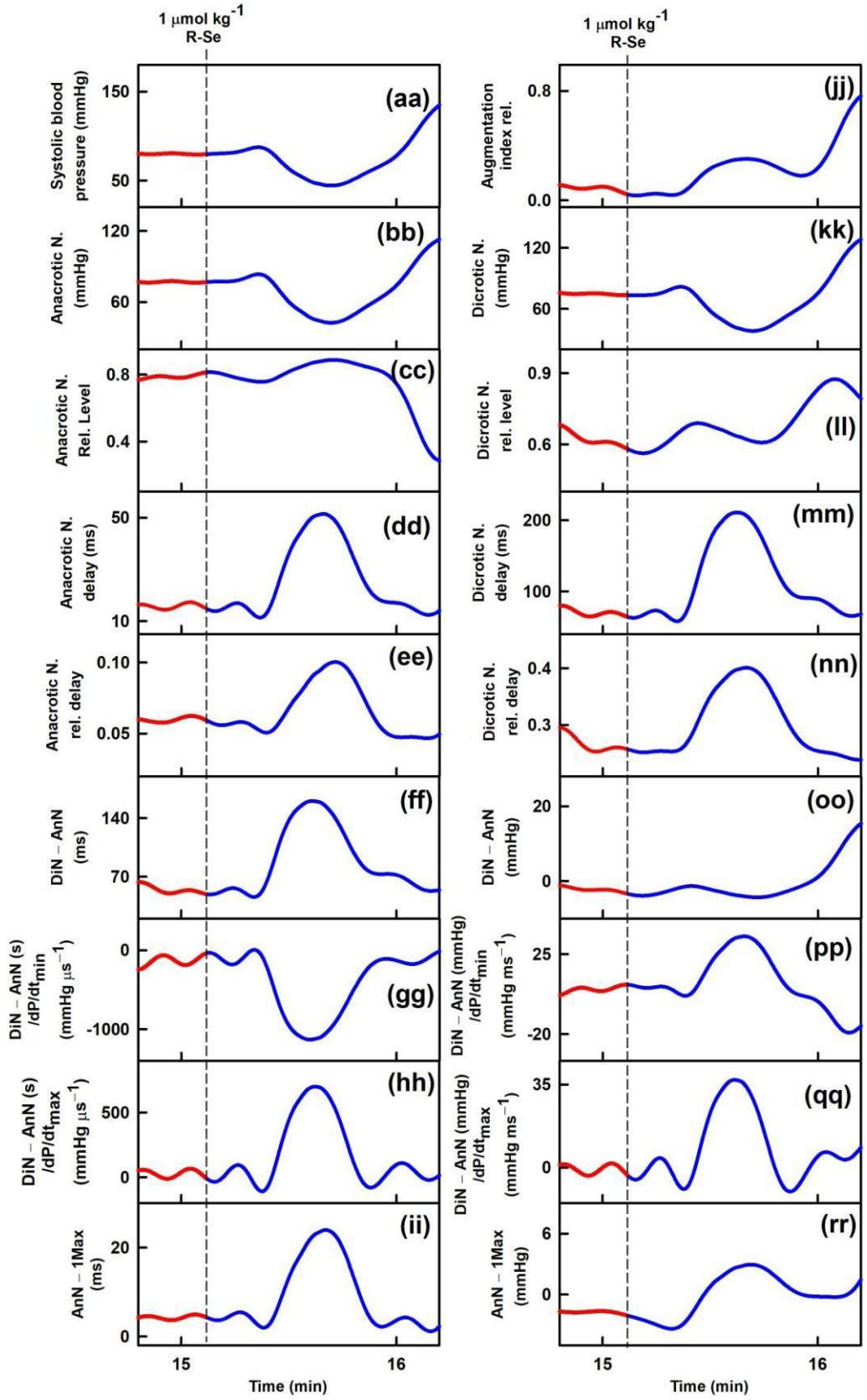
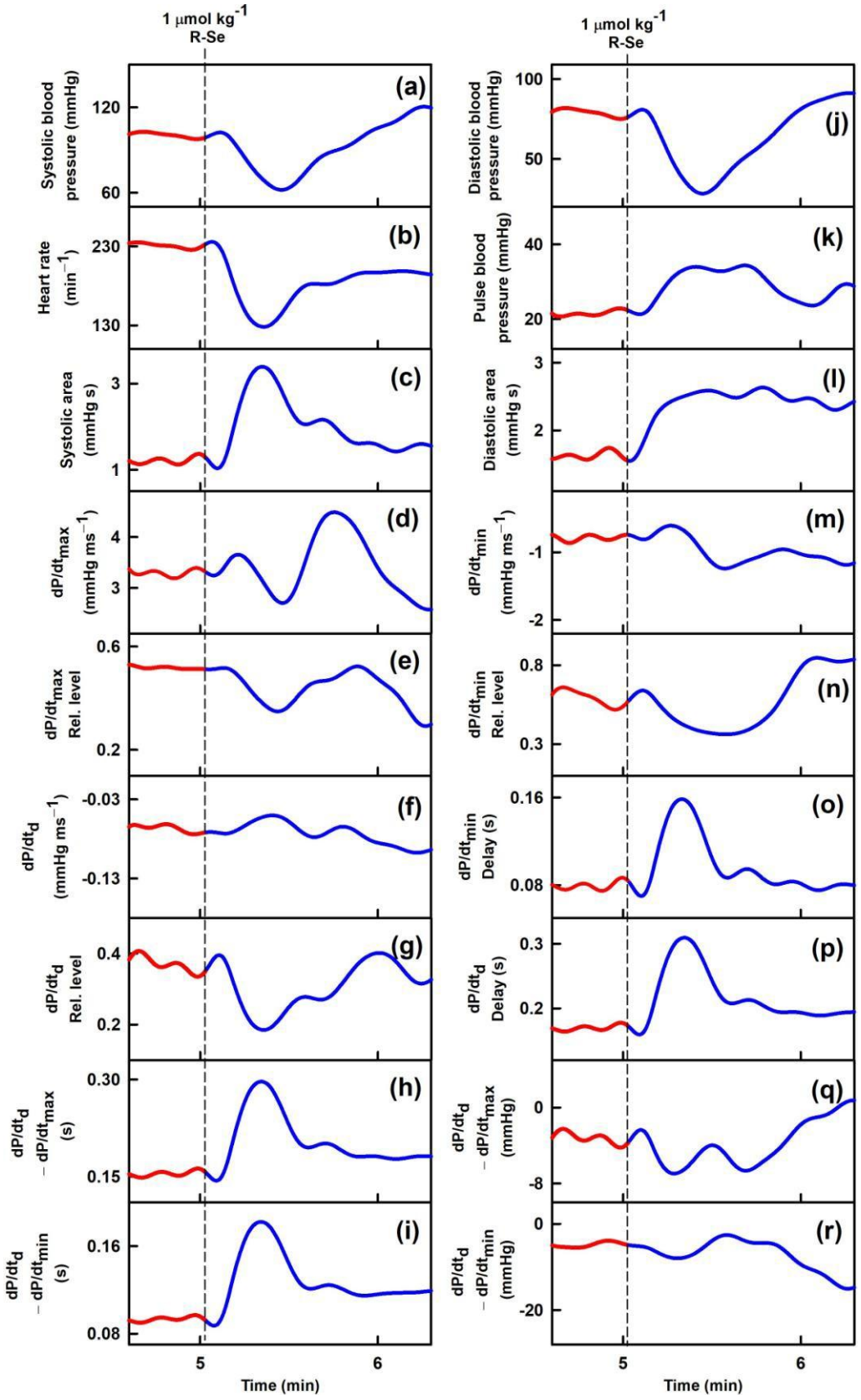


Figure S2. Time-dependent changes of 35 APW-Ps of anaesthetized rat before (red) and after IV bolus (15 s) administration of 1 μmol kg^{-1} phthalic selenoanhydride (R-Se, blue). Vertical dash lines indicate start of R-Se administration. Definitions, units and abbreviations of APW-Ps evaluated from the APW are explained in [1,2] and briefly in Figure S1.


1 μmol kg-1
R-Se
Systolic blood pressure (mmHg)
120
60
(a)
Heart rate (min−1)
230
130
(b)
Systolic area (mmHg s)
3
1
(c)
dP/dtmax (mmHg ms−1)
4
3
(d)
dP/dtmax Rel. level
0.6
0.2
(e)
dP/dtd (mmHg ms−1)
-0.03
-0.13
(f)
dP/dtd Rel. level
0.4
0.2
(g)
dP/dtd − dP/dtmax (s)
0.30
0.15
(h)
dP/dtd − dP/dtmin (s)
0.16
0.08
(i)
5
6
Time (min)
1 μmol kg-1
R-Se
Diastolic blood pressure (mmHg)
100
50
(j)
Pulse blood pressure (mmHg)
40
20
(k)
Diastolic area (mmHg s)
3
2
(l)
dP/dtmin (mmHg ms−1)
-1
-2
(m)
dP/dtmin Rel. level
0.8
0.3
(n)
dP/dtmin Delay (s)
0.16
0.08
(o)
dP/dtd Delay (s)
0.3
0.2
(p)
dP/dtd − dP/dtmax (mmHg)
0
-8
(q)
dP/dtd − dP/dtmin (mmHg)
0
-20
(r)
5
6
Time (min)

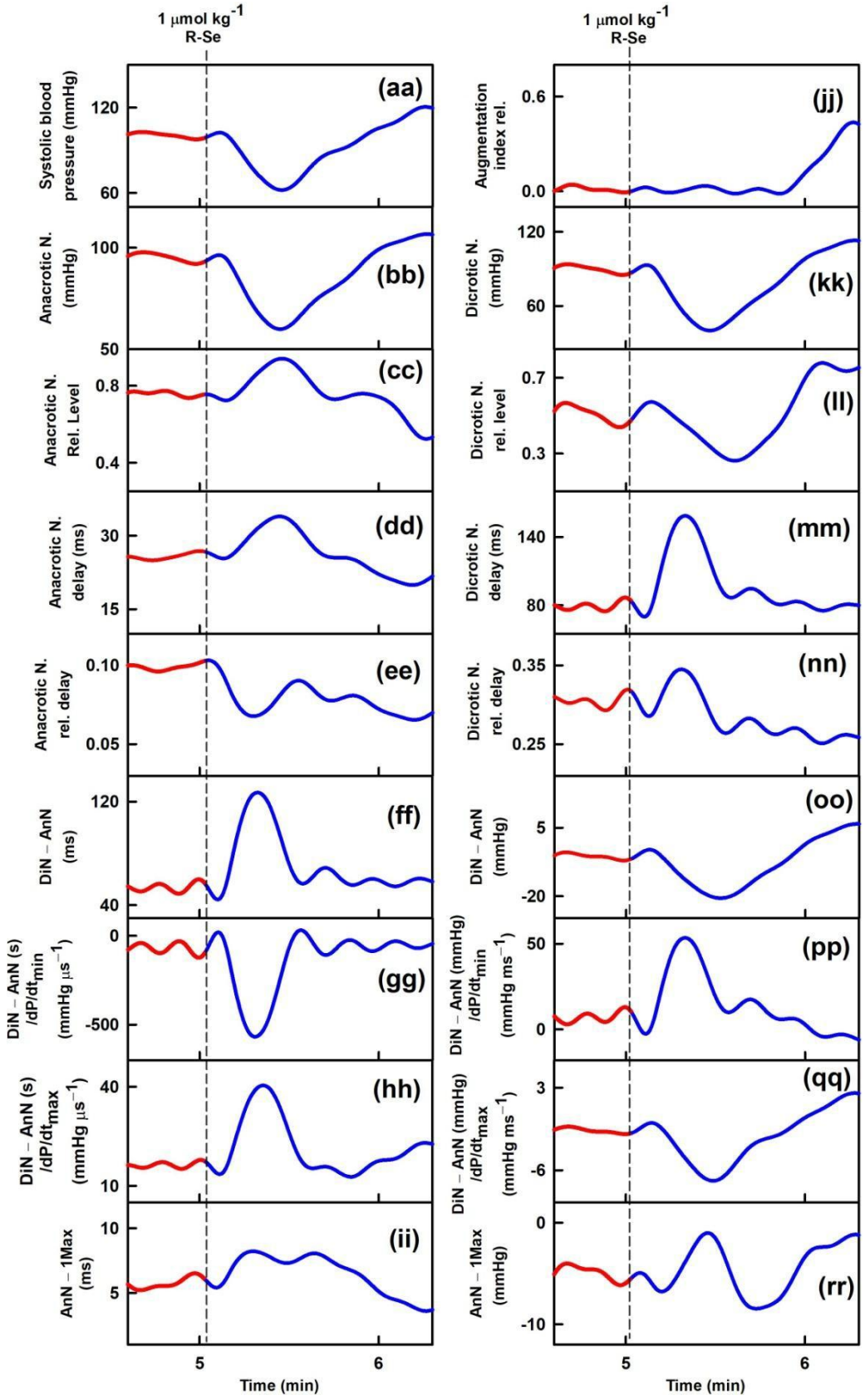
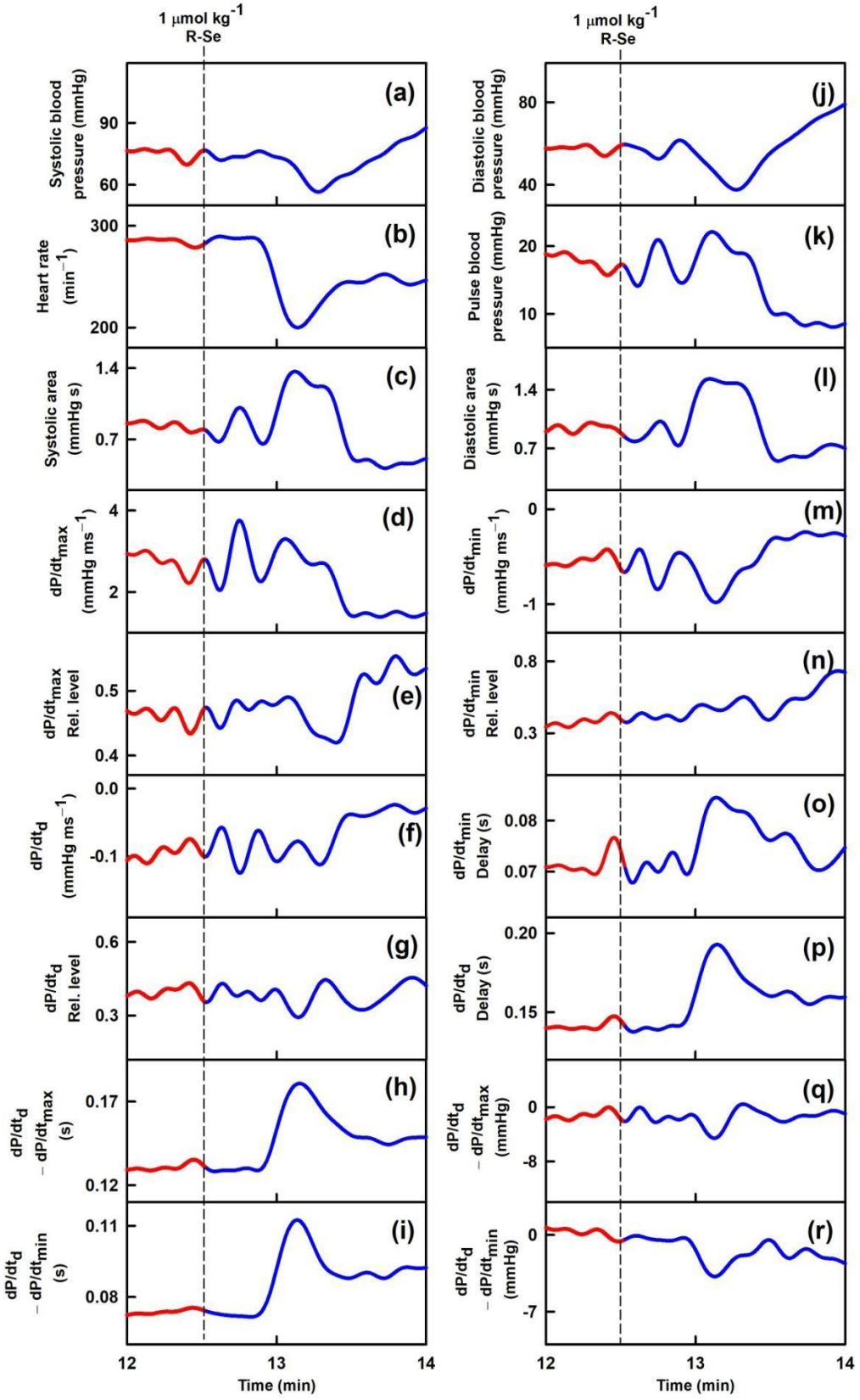


Figure S3. Time-dependent changes of 35 APW-Ps of anaesthetized rat before (red) and after IVIV bolus (15 s) administration of 1 μmol kg^{-1} R-Se (blue). Vertical dash lines indicate start of R-Se administration. Definitions, units and abbreviations of APW-Ps evaluated from the APW are explained in [1,2] and briefly in Figure S1.


1 μmol kg-1
R-Se
(a)
Systolic blood pressure (mmHg)
90
60
(b)
Heart rate (min−1)
300
200
(c)
Systolic area (mmHg s)
1.4
0.7
(d)
dP/dtmax (mmHg ms−1)
4
2
(e)
dP/dtmax Rel. level
0.5
0.4
(f)
dP/dtd (mmHg ms−1)
0.0
-0.1
(g)
dP/dtd Rel. level
0.6
0.3
(h)
dP/dtd – dP/dtmax (s)
0.17
0.12
(i)
dP/dtd – dP/dtmin (s)
0.11
0.08
12
13
14
Time (min)
1 μmol kg-1
R-Se
(j)
Diastolic blood pressure (mmHg)
80
40
(k)
Pulse blood pressure (mmHg)
20
10
(l)
Diastolic area (mmHg s)
1.4
0.7
(m)
dP/dtmin (mmHg ms−1)
0
-1
(n)
dP/dtmin Rel. level
0.8
0.3
(o)
dP/dtmin Delay (s)
0.08
0.07
(p)
dP/dtd Delay (s)
0.20
0.15
(q)
dP/dtd – dP/dtmax (mmHg)
0
-8
(r)
dP/dtd – dP/dtmin (mmHg)
0
-7
12
13
14
Time (min)

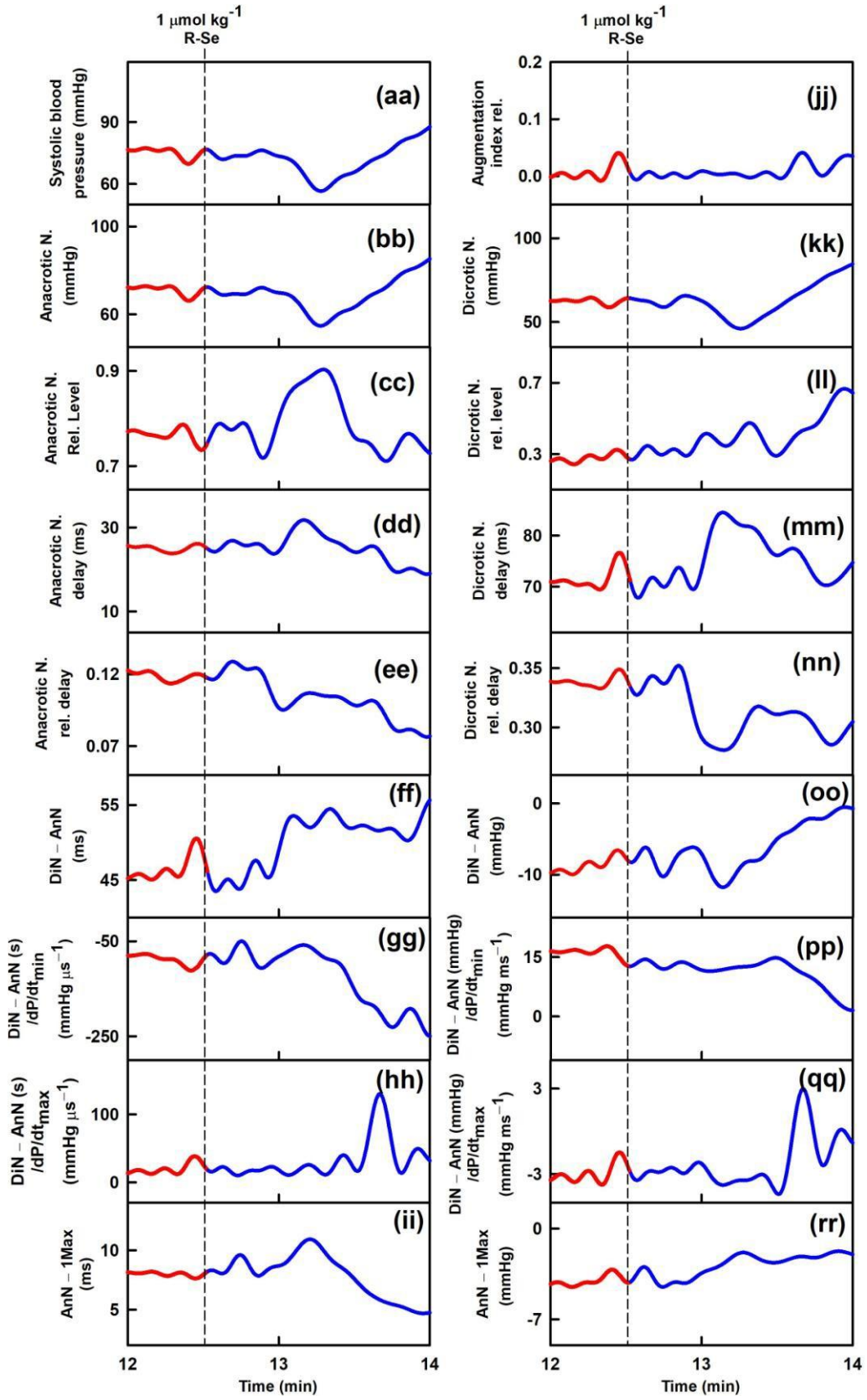
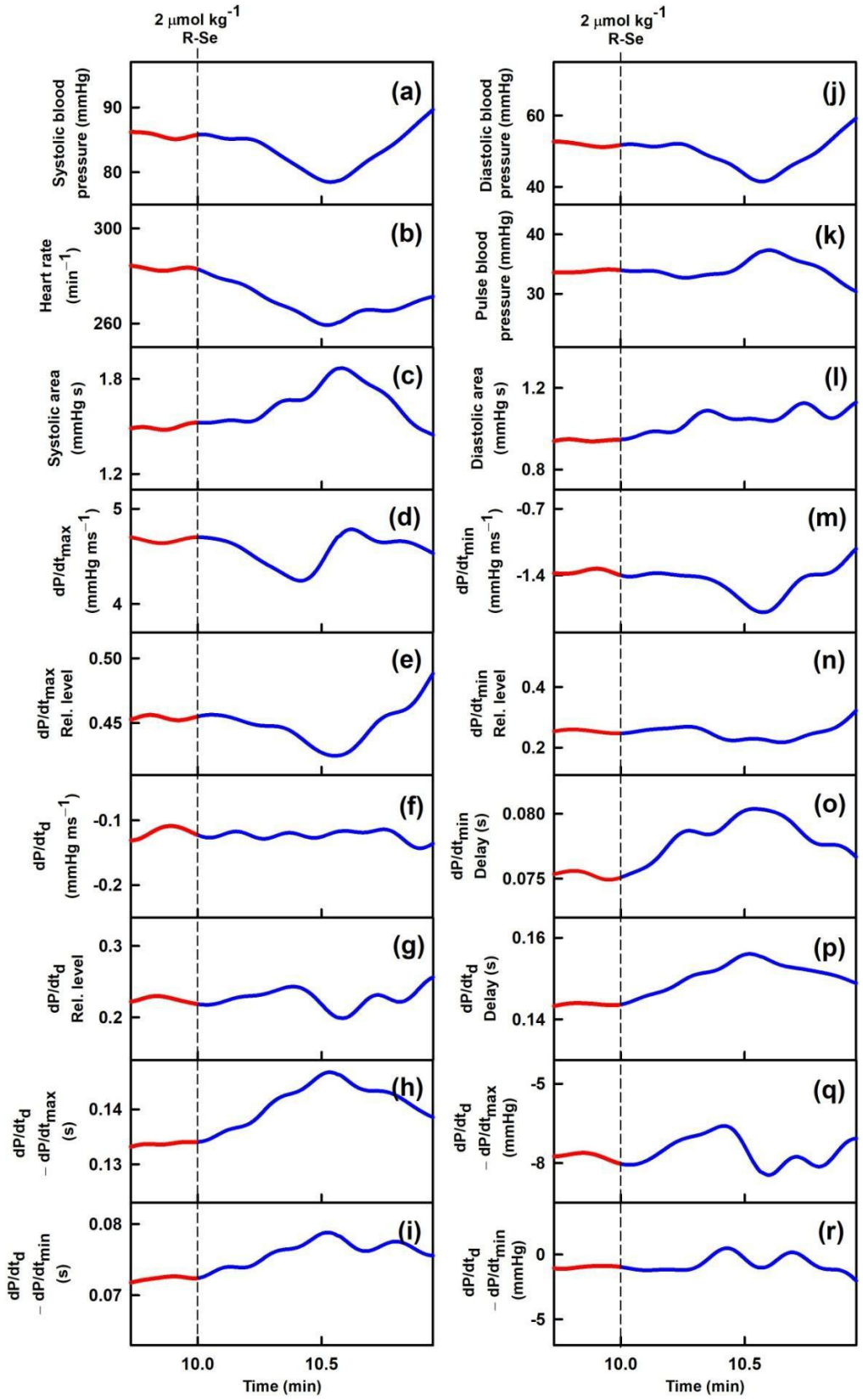


Figure S4. Time-dependent changes of 35 APW-Ps of anaesthetized rat before (red) and after IV bolus (15 s) administration of 1 μmol kg^{-1} R-Se (blue). Vertical dash lines indicate start of R-Se administration. Definitions, units and abbreviations of APW-Ps evaluated from the APW are explained in [1,2] and briefly in Figure S1.


2 μmol kg-1
R-Se
Systolic blood pressure (mmHg)
90
80
(a)
Heart rate (min−1)
300
260
(b)
Systolic area (mmHg s)
1.8
1.2
(c)
dP/dtmax (mmHg ms−1)
5
4
(d)
dP/dtmax Rel. level
0.50
0.45
(e)
dP/dtd (mmHg ms−1)
-0.1
-0.2
(f)
dP/dtd Rel. level
0.3
0.2
(g)
dP/dtd – dP/dtmax (s)
0.14
0.13
(h)
dP/dtd – dP/dtmin (s)
0.08
0.07
(i)
10.0
10.5
Time (min)
2 μmol kg-1
R-Se
Diastolic blood pressure (mmHg)
60
40
(j)
Pulse blood pressure (mmHg)
40
30
(k)
Diastolic area (mmHg s)
1.2
0.8
(l)
dP/dtmin (mmHg ms−1)
-0.7
-1.4
(m)
dP/dtmin Rel. level
0.4
0.2
(n)
dP/dtmin Delay (s)
0.080
0.075
(o)
dP/dtd Delay (s)
0.16
0.14
(p)
dP/dtd – dP/dtmax (mmHg)
-5
-8
(q)
dP/dtd – dP/dtmin (mmHg)
0
-5
(r)
10.0
10.5
Time (min)

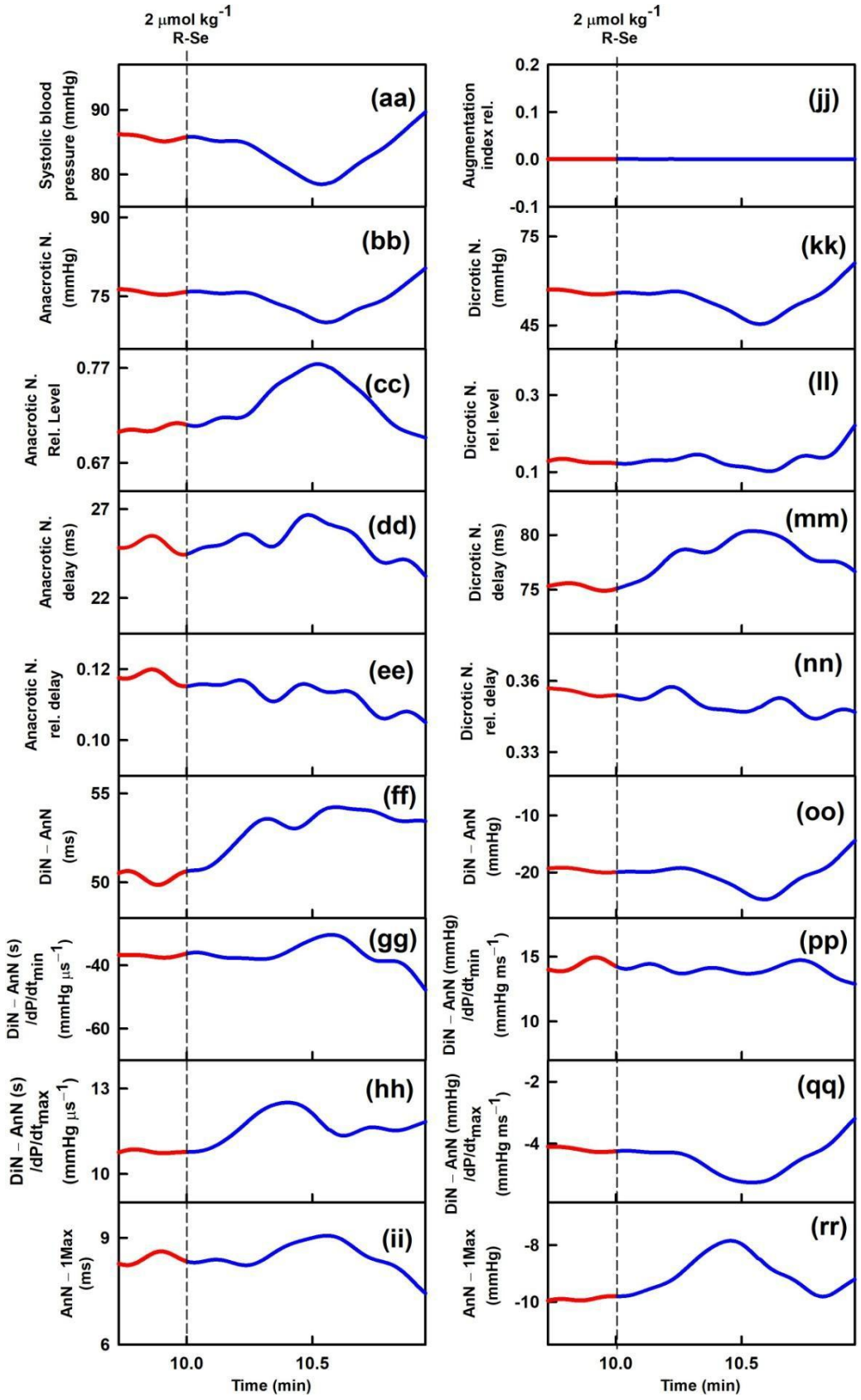
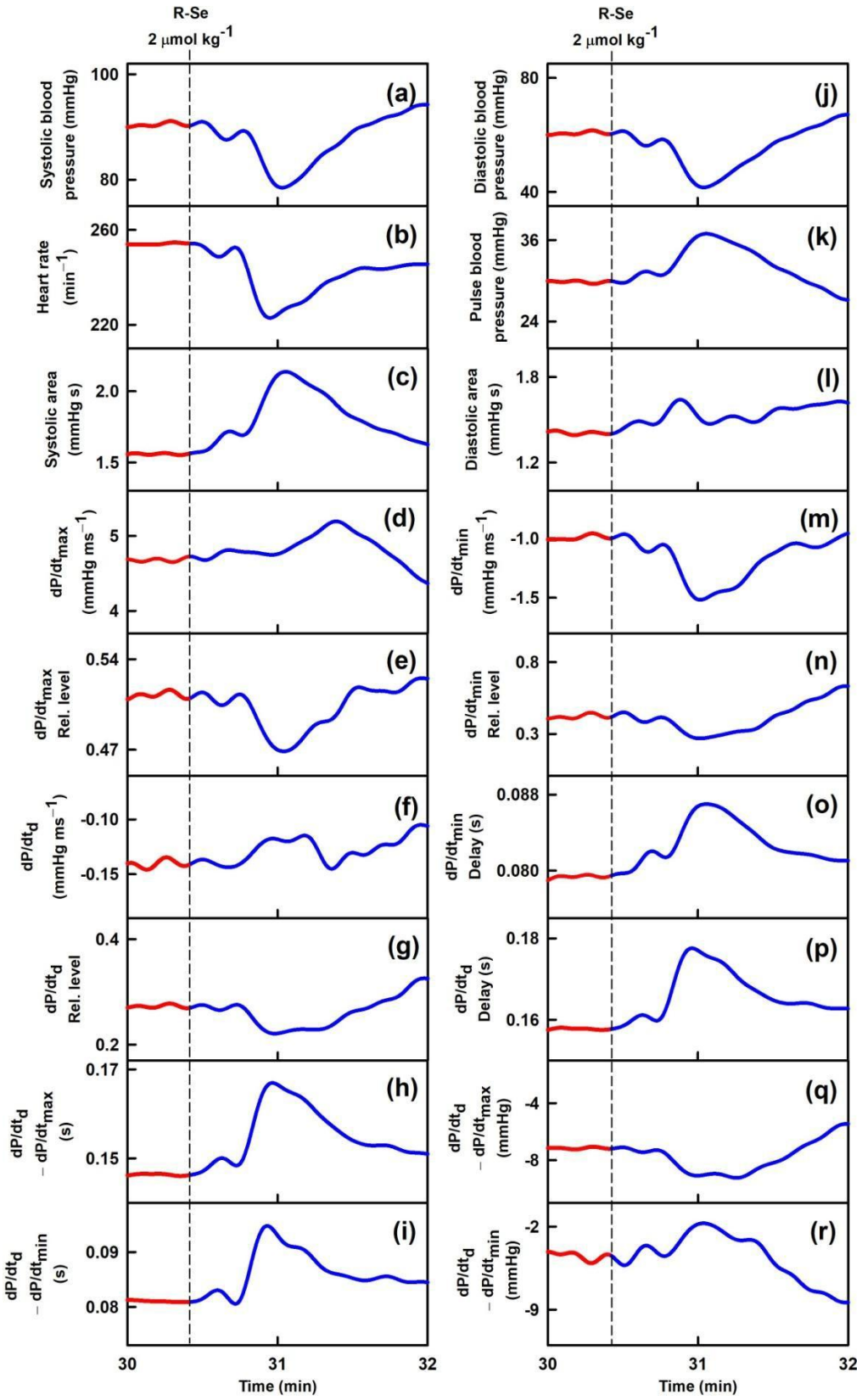


Figure S5. Time-dependent changes of 35 APW-Ps of anaesthetized rat before (red) and after IV bolus (15 s) administration of 2 μmol kg^{-1} R-Se (blue). Vertical dash lines indicate start of R-Se administration. Definitions, units and abbreviations of APW-Ps evaluated from the APW are explained in [1,2] and briefly in Figure S1.


R-Se
2 μmol kg-1
Systolic blood pressure (mmHg)
100
80
(a)
Heart rate (min-1)
260
220
(b)
Systolic area (mmHg s)
2.0
1.5
(c)
dP/dtmax (mmHg ms-1)
5
4
(d)
dP/dtmax Rel. level
0.54
0.47
(e)
dP/dtd (mmHg ms-1)
-0.10
-0.15
(f)
dP/dtd Rel. level
0.4
0.2
(g)
dP/dtd – dP/dtmax (s)
0.17
0.15
(h)
dP/dtd – dP/dtmin (s)
0.09
0.08
(i)
30
31
32
Time (min)
R-Se
2 μmol kg-1
Diastolic blood pressure (mmHg)
80
40
(j)
Pulse blood pressure (mmHg)
36
24
(k)
Diastolic area (mmHg s)
1.8
1.2
(l)
dP/dtmin (mmHg ms-1)
-1.0
-1.5
(m)
dP/dtmin Rel. level
0.8
0.3
(n)
dP/dtmin Delay (s)
0.088
0.080
(o)
dP/dtd Delay (s)
0.18
0.16
(p)
dP/dtd – dP/dtmax (mmHg)
-4
-8
(q)
dP/dtd – dP/dtmin (mmHg)
-2
-9
(r)
30
31
32
Time (min)

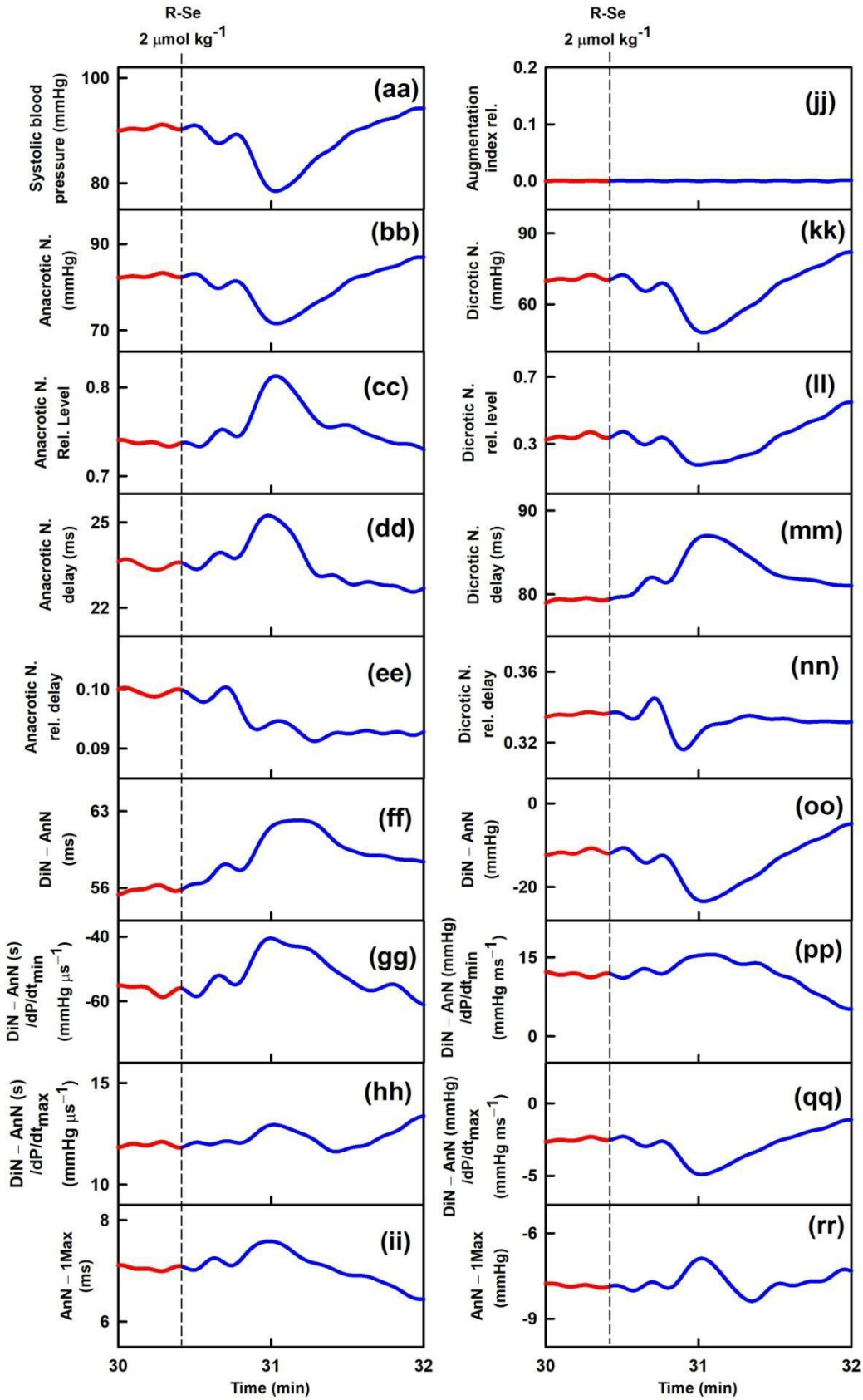
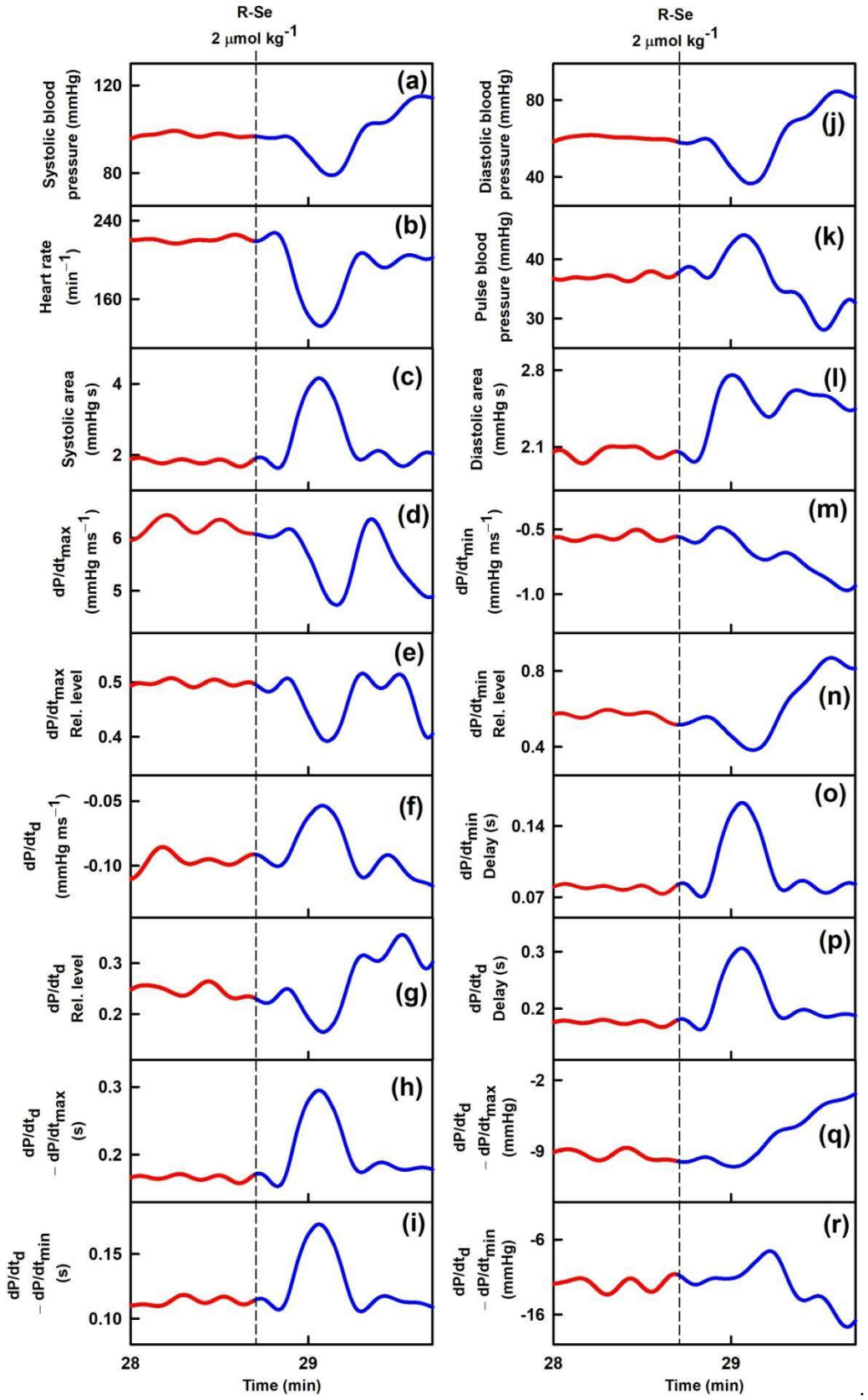


Figure S6. Time-dependent changes of 35 APW-Ps of anaesthetized rat before (red) and after IV bolus (15 s) administration of 2 μmol kg^{-1} R-Se (blue). Vertical dash lines indicate start of R-Se administration. Definitions, units and abbreviations of APW-Ps evaluated from the APW are explained in [1,2] and briefly in Figure S1.


R-Se
2 μmol kg-1
Systolic blood pressure (mmHg)
120
80
(a)
Heart rate (min-1)
240
160
(b)
Systolic area (mmHg s)
4
2
(c)
dP/dtmax (mmHg ms-1)
6
5
(d)
dP/dtmax Rel. level
0.5
0.4
(e)
dP/dtd (mmHg ms-1)
-0.05
-0.10
(f)
dP/dtd Rel. level
0.3
0.2
(g)
dP/dtd – dP/dtmax (s)
0.3
0.2
(h)
dP/dtd – dP/dtmin (s)
0.15
0.10
(i)
28
29
Time (min)
R-Se
2 μmol kg-1
Diastolic blood pressure (mmHg)
80
40
(j)
Pulse blood pressure (mmHg)
40
30
(k)
Diastolic area (mmHg s)
2.8
2.1
(l)
dP/dtmin (mmHg ms-1)
-0.5
-1.0
(m)
dP/dtmin Rel. level
0.8
0.4
(n)
dP/dtmin Delay (s)
0.14
0.07
(o)
dP/dtd Delay (s)
0.3
0.2
(p)
dP/dtd – dP/dtmax (mmHg)
-2
-9
(q)
dP/dtd – dP/dtmin (mmHg)
-6
-16
(r)
28
29
Time (min)

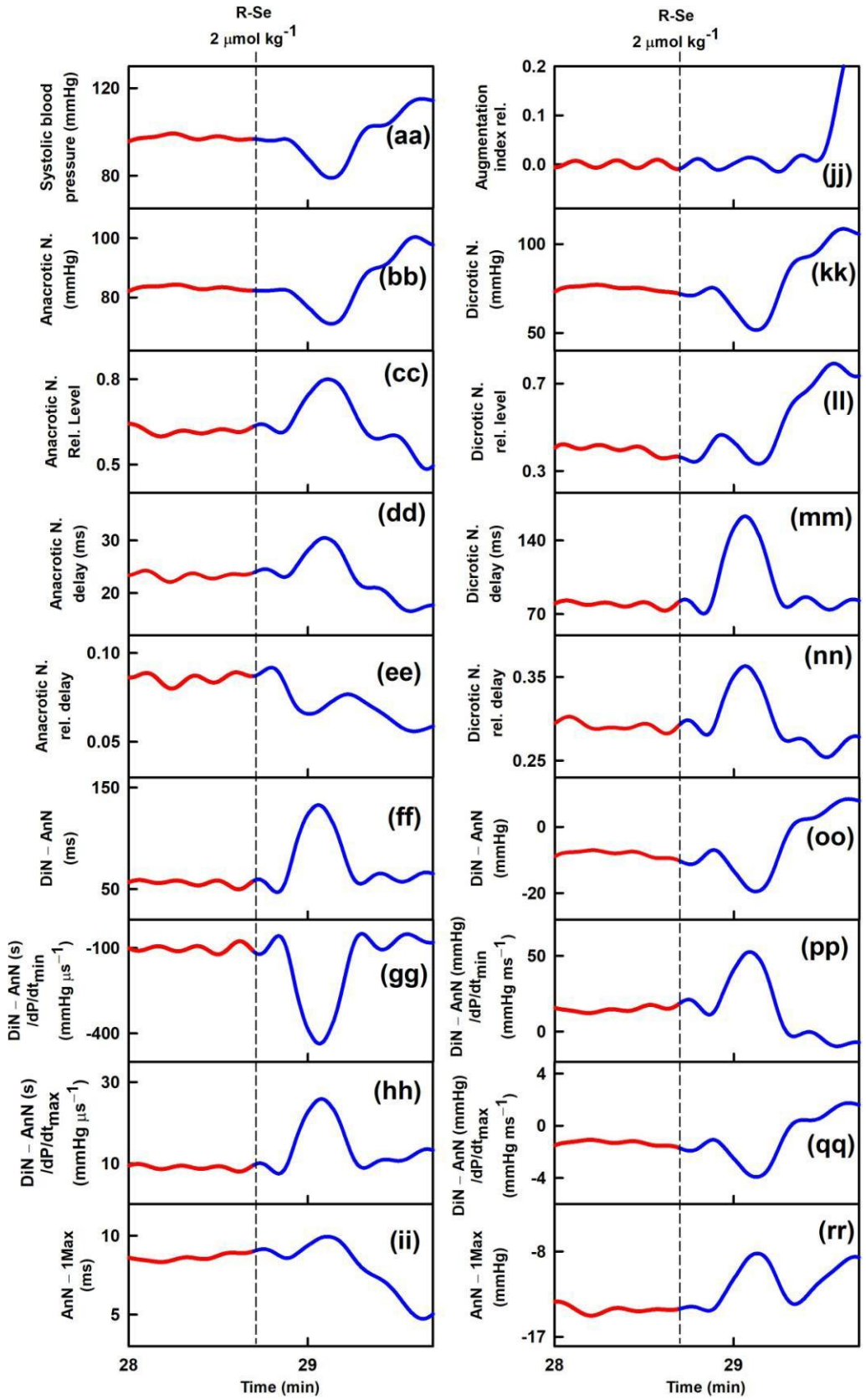
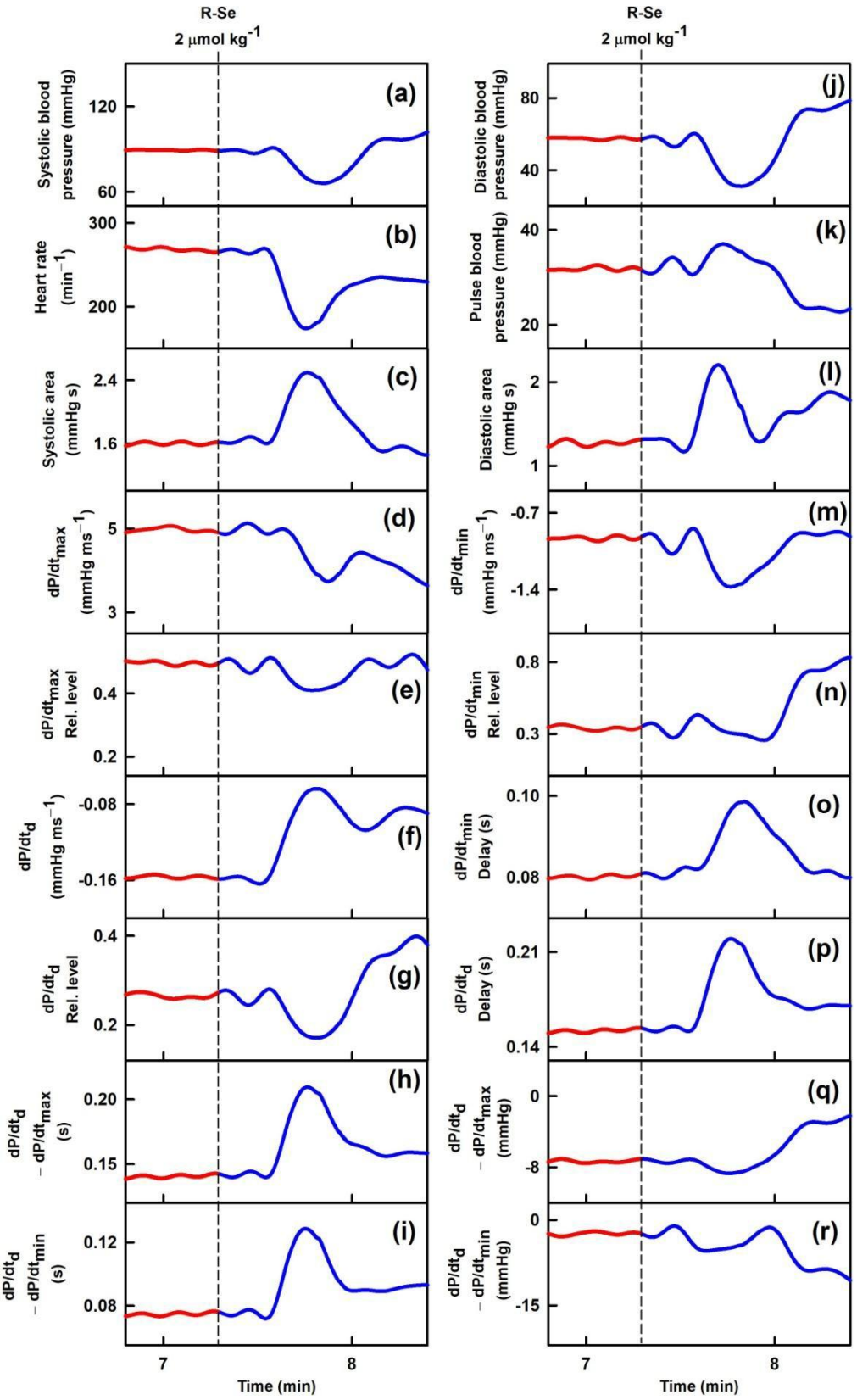


Figure S7. Time-dependent changes of 35 APW-Ps of anaesthetized rat before (red) and after IV bolus (15 s) administration of 2 μmol kg^{-1} R-Se (blue). Vertical dash lines indicate start of R-Se administration. Definitions, units and abbreviations of APW-Ps evaluated from the APW are explained in [1,2] and briefly in Figure S1.


R-Se
2 μmol kg-1
(a)
Systolic blood pressure (mmHg)
120
60
(b)
Heart rate (min−1)
300
200
(c)
Systolic area (mmHg s)
2.4
1.6
(d)
dP/dtmax (mmHg ms−1)
5
3
(e)
dP/dtmax Rel. level
0.4
0.2
(f)
dP/dtd (mmHg ms−1)
-0.08
-0.16
(g)
dP/dtd Rel. level
0.4
0.2
(h)
dP/dtd – dP/dtmax (s)
0.20
0.15
(i)
dP/dtd – dP/dtmin (s)
0.12
0.08
7
8
Time (min)
R-Se
2 μmol kg-1
(j)
Diastolic blood pressure (mmHg)
80
40
(k)
Pulse blood pressure (mmHg)
40
20
(l)
Diastolic area (mmHg s)
2
1
(m)
dP/dtmin (mmHg ms−1)
-0.7
-1.4
(n)
dP/dtmin Rel. level
0.8
0.3
(o)
dP/dtmin Delay (s)
0.10
0.08
(p)
dP/dtd Delay (s)
0.21
0.14
(q)
dP/dtd – dP/dtmax (mmHg)
0
-8
(r)
dP/dtd – dP/dtmin (mmHg)
0
-15
7
8
Time (min)

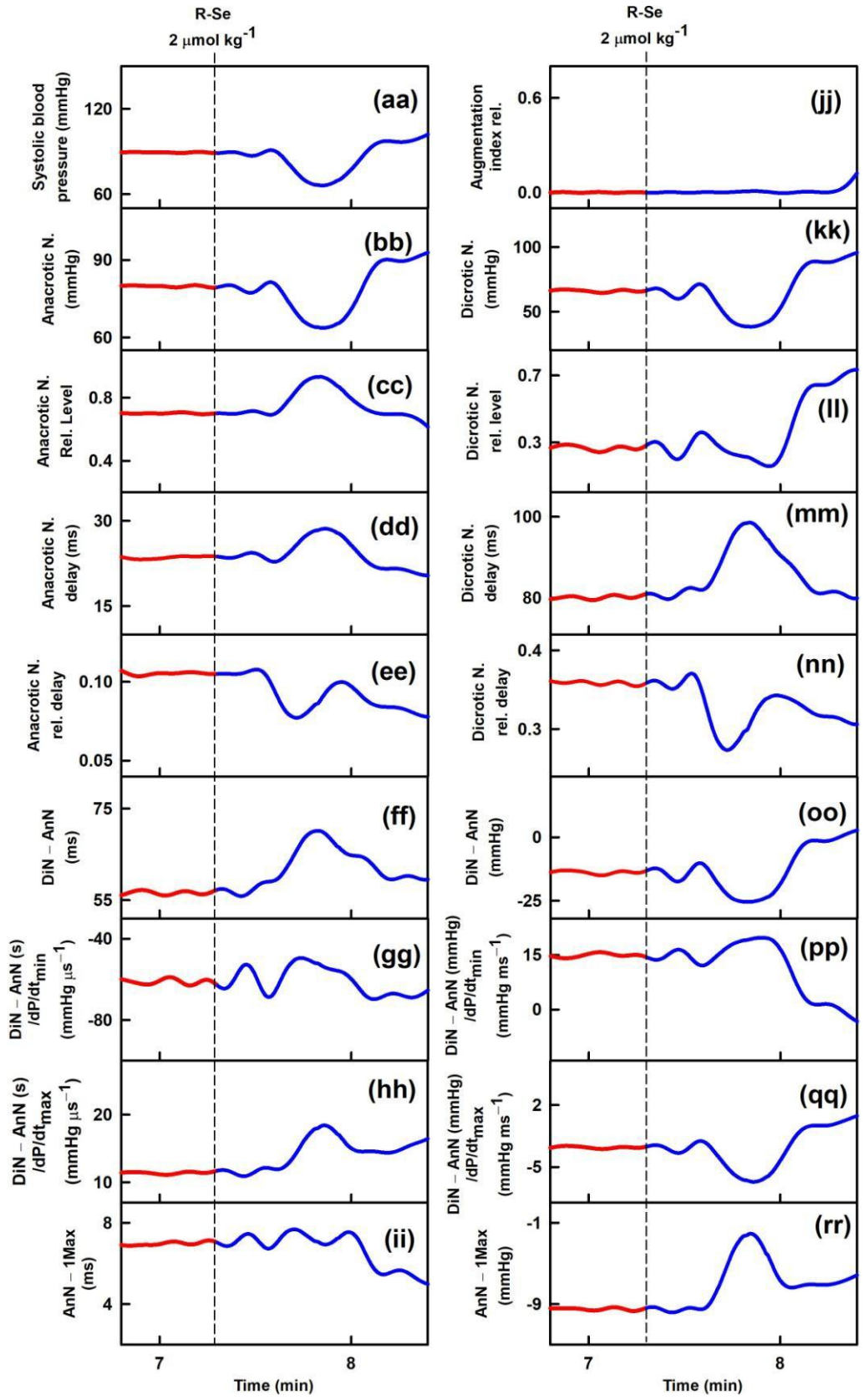
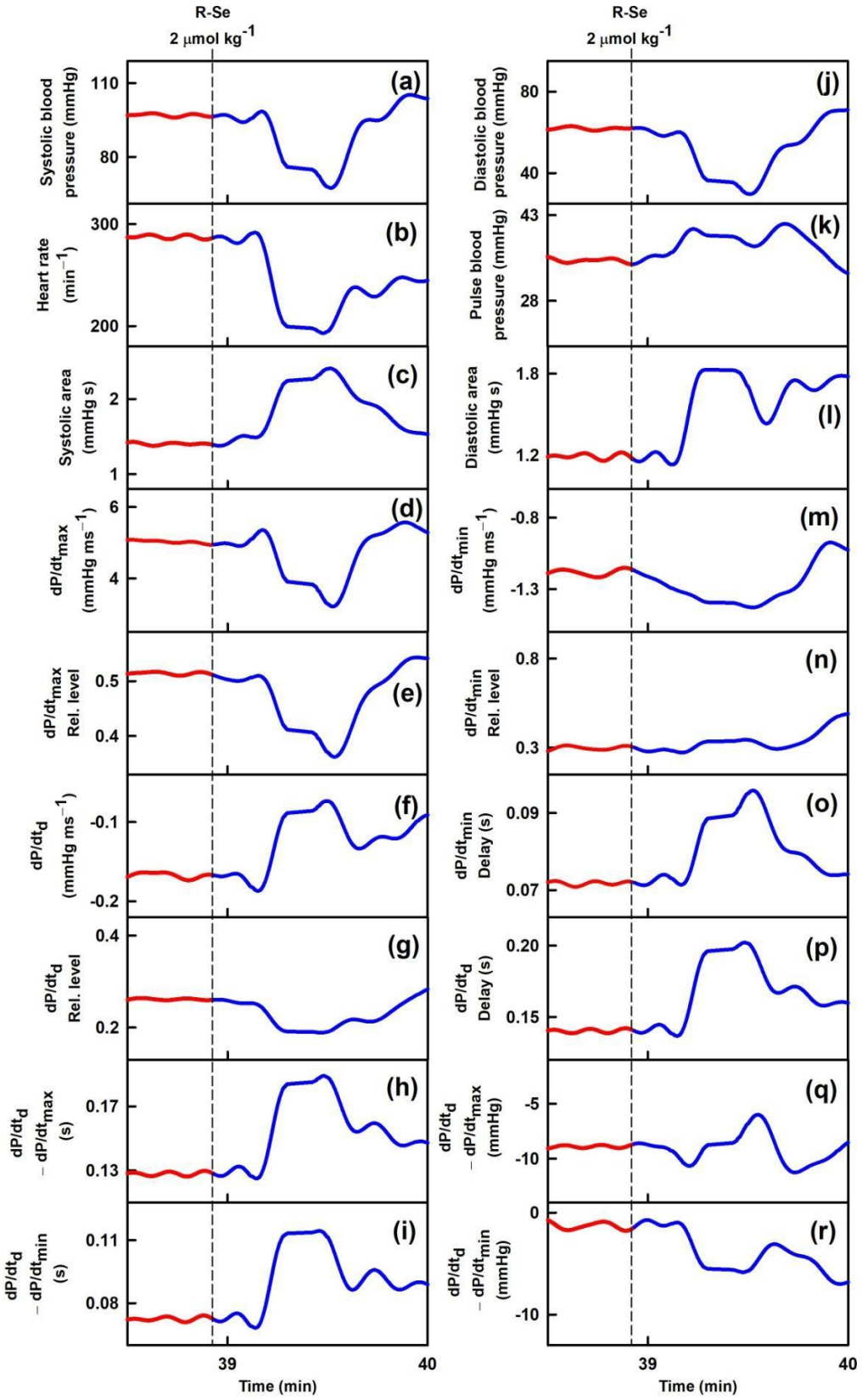


Figure S8. Time-dependent changes of 35 APW-Ps of anaesthetized rat before (red) and after IV bolus (15 s) administration of 2 μmol kg^{-1} R-Se (blue). Vertical dash lines indicate start of R-Se administration. Definitions, units and abbreviations of APW-Ps evaluated from the APW are explained in [1,2] and briefly in Figure S1.


R-Se
2 μmol kg-1
Systolic blood pressure (mmHg)
110
80
(a)
Heart rate (min-1)
300
200
(b)
Systolic area (mmHg s)
2
1
(c)
dP/dtmax (mmHg ms-1)
6
4
(d)
dP/dtmax Rel. level
0.5
0.4
(e)
dP/dtd (mmHg ms-1)
-0.1
-0.2
(f)
dP/dtd Rel. level
0.4
0.2
(g)
dP/dtd – dP/dtmax (s)
0.17
0.13
(h)
dP/dtd – dP/dtmin (s)
0.11
0.08
(i)
39
40
Time (min)
R-Se
2 μmol kg-1
Diastolic blood pressure (mmHg)
80
40
(j)
Pulse blood pressure (mmHg)
43
28
(k)
Diastolic area (mmHg s)
1.8
1.2
(l)
dP/dtmin (mmHg ms-1)
-0.8
-1.3
(m)
dP/dtmin Rel. level
0.8
0.3
(n)
dP/dtmin Delay (s)
0.09
0.07
(o)
dP/dtd Delay (s)
0.20
0.15
(p)
dP/dtd – dP/dtmax (mmHg)
-5
-10
(q)
dP/dtd – dP/dtmin (mmHg)
0
-10
(r)
39
40
Time (min)

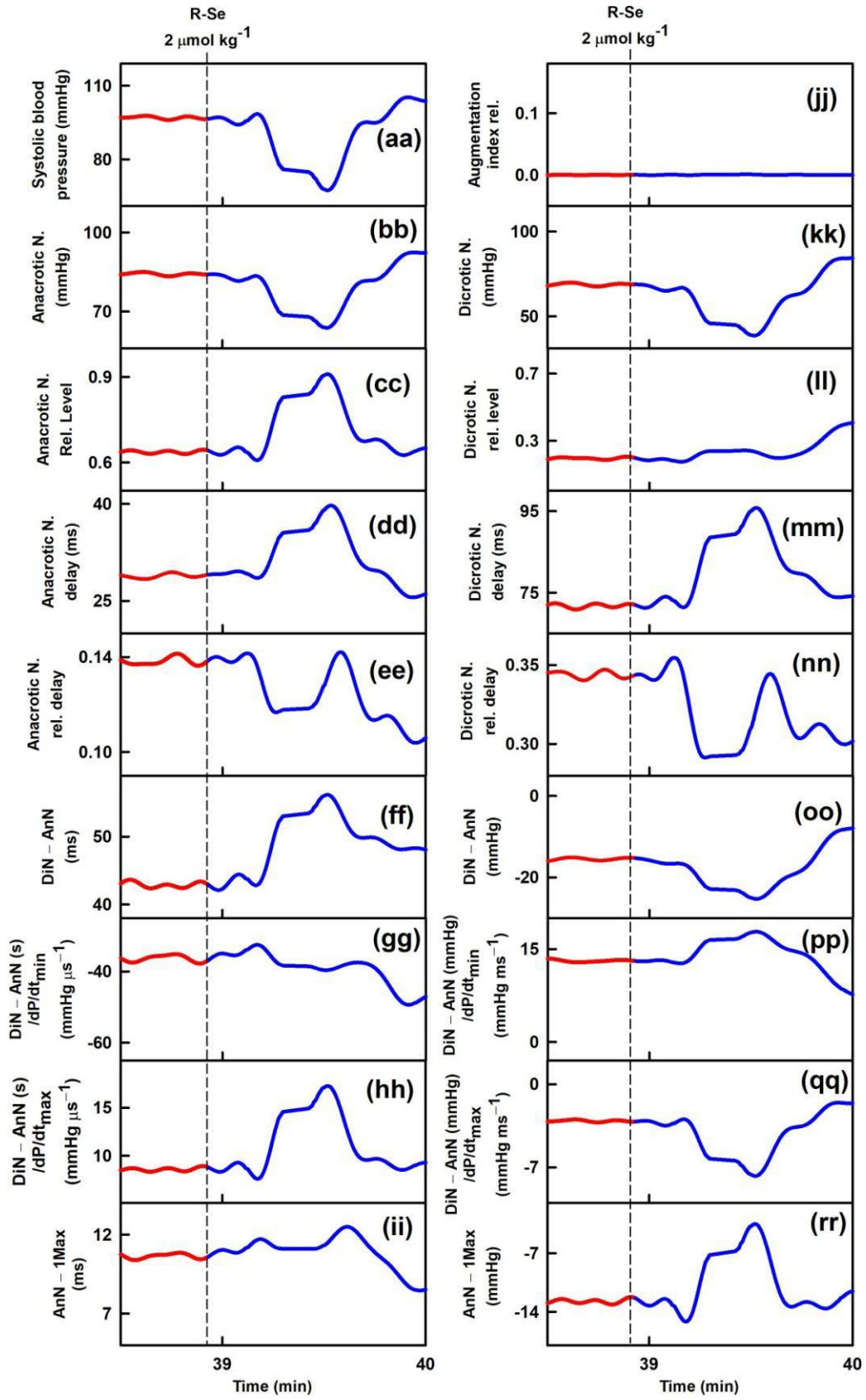


Figure S9. Time-dependent changes of 35 APW-Ps of anaesthetized rat before (red) and after IV bolus (15 s) administration of 2 μmol kg^{-1} R-Se (blue). Vertical dash lines indicate start of R-Se administration. Definitions, units and abbreviations of APW-Ps evaluated from the APW are explained in [1,2] and briefly in Figure S1.

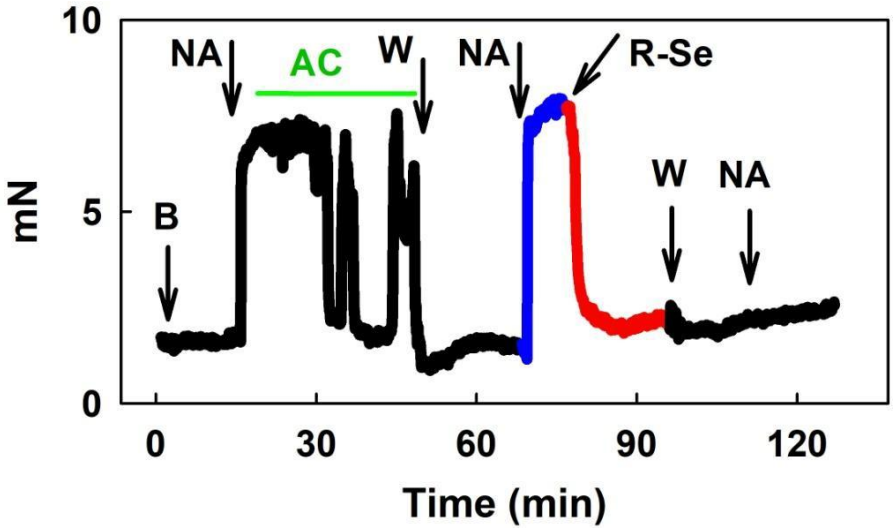


Figure S10. Original recording of the vascular reactivity of the mesenteric artery.
B indicates baseline. Vascular segment was pre-contracted with noradrenaline (**NA**, 10 μmol L^{-1}). Acetylcholine was added in a cumulative manner (**AC**, 1 nmol L^{-1} - 10 μmol L^{-1}). The vessel was washed four times (**W**) and re-contracted with **NA**. After stabilization of the tension, **R-Se** (12.5 μmol L^{-1}) was applied. The vessel was washed four times again (**W**) and **NA** (10 μmol L^{-1}) was applied.

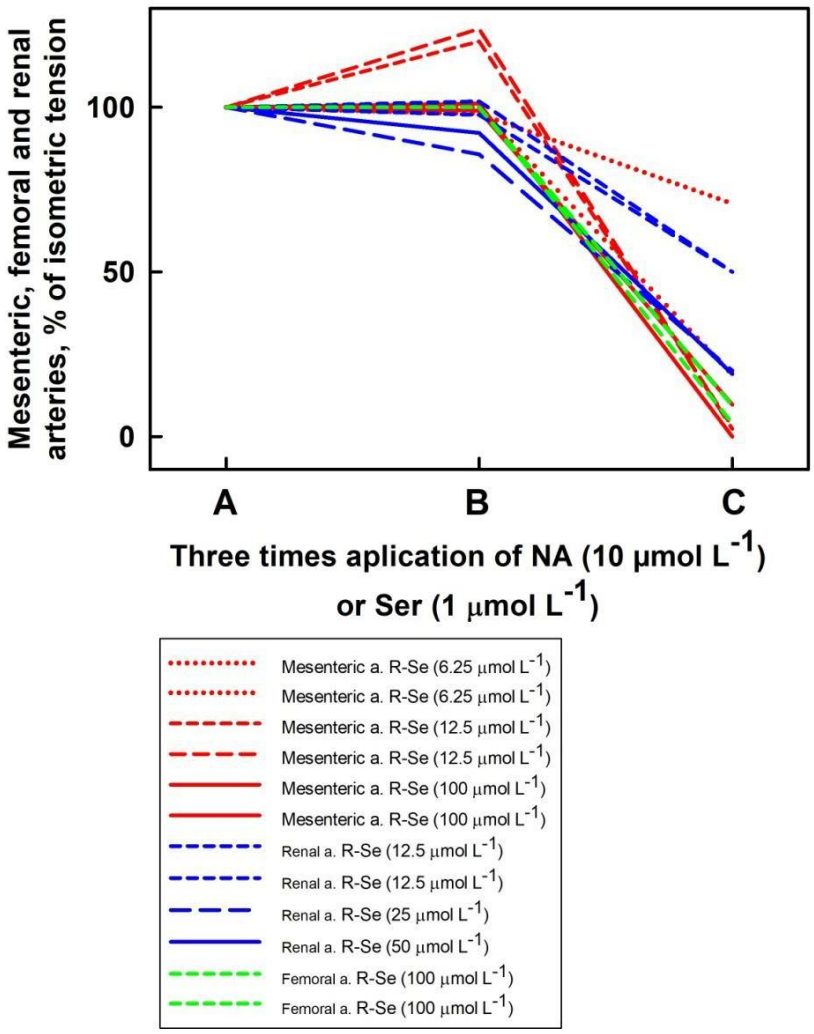


Figure S11. The comparison of noradrenaline (NA, 10 μmol L^{-1}) or serotonin (Ser, 1 μmol L^{-1}) potency to increase tension of the mesenteric, renal and femoral arteries during control measurement of vascular endothelium function (A), before application of R-Se (B) and after wash out of R-Se (C). For details see Figure S10.

References

1. Kurakova, L.; Misak, A.; Tomasova, L.; Cacanyiova, S.; Berenyiova, A.; Ondriasova, E.; Balis, P.; Grman, M.; Ondrias, K. Mathematical relationships of patterns of 35 rat haemodynamic parameters for conditions of hypertension resulting from decreased nitric oxide bioavailability. *Exp. Physiol.* **2020**, *105*, 312-334.
2. Tomasova, L.; Grman, M.; Misak, A.; Kurakova, L.; Ondriasova, E.; Ondrias, K. Cardiovascular "Patterns" of H_2S and $SSNO^-$-Mix Evaluated from 35 Rat Hemodynamic Parameters. *Biomolecules* **2021**, *11*, 293.