

Supplementary Appendix S1. Search Strategy

Database: Embase Classic+Embase <1965 to 2018 >, Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) <1946 to Present> Search Strategy:

- 1 exp Renal Insufficiency, Chronic/ (138762)
- 2 exp Kidney Diseases/ and Chronic Disease/ (22043)
- 3 ((kidney* or renal) adj1 (disease* or failure* or impair* or insufficien*)).tw. (397987)
- 4 (ESRD or ESKD or ESRF or CKD).tw. (55275)
- 5 exp Renal Dialysis/ (231814)
- 6 (dialys#s or hemodialys#s or haemodialys#s or hemo-dialys#s or haemo-dialys#s or hemofiltration or haemofiltration or hemo-filtration or haemo-filtration or hemodiafiltration or haemodiafiltration or hemo-diafiltration or haemo-diafiltration).tw. (278398)
- 7 (CAPD or CCPD).tw. (13729)
- 8 ((kidney* or renal) adj1 replacement therap*).tw. (17650)
- 9 or/1-8 (669133)
- 10 Pulse/ (57856)
- 11 Pulse Wave Analysis/ (7505)
- 12 ((pulse or pulsation) adj2 (curve* or tracing* or wave*)).tw. (22791)
- 13 (PWV or aPWV or BaPWV or cfPWV).tw. (8939)
- 14 (pulse adj2 (analys\$s or velocit* or transit time*)).tw. (13966)
- 15 Vascular Stiffness/ (10313)
- 16 ((vascular or aortic or arter*) adj2 (stiffness or stiffening or rigidity)).tw. (17415)
- 17 ((decreased or reduced or diminished or lessened or lowered) adj3 ((vascular or aortic or arter*) adj compliance)).tw. (951)
- 18 Blood Flow Velocity/ (85004)
- 19 ((blood or circulation) adj2 (flow or rate) adj velocit*).tw. (15905)
- 20 (central adj (pulse or aortic or arterial) adj pressure).tw. (1485)
- 21 (central pressure or pulse pressure or pulse tension).tw. (15833)
- 22 AASI.tw. (320)
- 23 applanation tonomet*.tw. (6198)
- 24 (SphygmoCor* or Vicorder*).tw. (1354)
- 25 ((assess* or measur* or determin* or evaluat*) adj3 ((vascular or aortic or arter*) adj elasticit*)).tw. (421)
- 26 or/10-25 (192443)
- 27 9 and 26 (7648)

- 28 exp Animals/ not (exp Animals/ and Humans/) (8740001)
29 27 not 28 (7339)
30 (comment or editorial or interview or letter or news).pt. (2821196)
31 29 not 30 (7163)
32 31 use prmz (2658)
33 chronic kidney failure/ (133258)
34 chronic kidney disease/ (38970)
35 ((kidney* or renal) adj1 (disease* or failure* or impair* or insufficien*)).tw. (397987)
36 (ESRD or ESKD or ESRF or CKD).tw. (55275)
37 exp renal replacement therapy/ (308934)
38 (dialys#s or hemodialys#s or haemodialys#s or hemo-dialys#s or haemo-dialys#s or hemofiltration or haemofiltration or hemo-filtration or haemo-filtration or hemodiafiltration or haemodiafiltration or hemo-diafiltration or haemo-diafiltration).tw. (278398)
39 (CAPD or CCPD).tw. (13729)
40 ((kidney* or renal) adj1 replacement therap*).tw. (17650)
41 or/33-40 (721858)
42 pulse wave/ (13721)
43 ((pulse or pulsation) adj2 (curve* or tracing* or wave*)).tw. (22791)
44 (PWV or aPWV or BaPWV or cfPWV).tw. (8939)
45 (pulse adj2 (analys\$s or velocit* or transit time*)).tw. (13966)
46 arterial stiffness/ (10324)
47 ((vascular or aortic or arter*) adj2 (stiffness or stiffening or rigidity)).tw. (17415)
48 ((decreased or reduced or diminished or lessened or lowered) adj3 ((vascular or aortic or arter*) adj compliance)).tw. (951)
49 blood flow velocity/ (85004)
50 ((blood or circulation) adj2 (flow or rate) adj velocit*).tw. (15905)
51 pulse pressure/ (246498)
52 (central pressure or pulse pressure or pulse tension).tw. (15833)
53 AASI.tw. (320)
54 applanation tonomet*.tw. (6198)
55 (SphygmoCor* or Vicorder*).tw. (1354)
56 ((assess* or measur* or determin* or evaluat*) adj3 ((vascular or aortic or arter*) adj elasticit*)).tw. (421)
57 or/42-56 (363761)
58 41 and 57 (16296)

59 exp animal experimentation/ or exp models animal/ or exp animal experiment/ or nonhuman/ or exp vertebrate/ (37664944)
60 exp humans/ or exp human experimentation/ or exp human experiment/ (28628906)
61 59 not 60 (9037681)
62 58 not 61 (14440)
63 (editorial or letter).pt. (2508169)
64 62 not 63 (13980)
65 64 use emezd (3778)
66 32 or 65 (6436)
67 limit 66 to yr=2000-current (5224)
68 remove duplicates from 67 (3751)
69 66 not 67 (1212)
70 remove duplicates from 69 (895)
71 68 or 70 (4646) [total unique refs]
72 71 use prmz (2605) [unique MEDLINE refs]
73 71 use emezd (2041) [unique Embase refs]

Supplementary Appendix S2. Study selection criteria (inclusion and exclusion).

	Inclusion criteria	Exclusion criteria
Patient population	Adults (≥ 18 years) with ESRD defined as stage 5 CKD (e-GFR <15 ml/min/1.73 m ²) of any duration and receiving or not any renal replacement therapy. Kidney transplant recipients who are not on dialysis therapy will be included if they had pre- and post-transplant assessments of their cf-PWV or were compared to controls on dialysis therapy.	Chronic Kidney Disease stages 1 to 4; Mix of patients with various stages of CKD if data on subjects with ESRD could not be abstracted; Population-based studies that do not include ESRD patients; Non-human studies; Pediatric populations (<18 years).
Intervention	We included interventions directed at: blood pressure, vascular inflammation, progression of vascular calcification, metabolic bone disease, extracellular fluid volume, and others that were associated with potential protective effects: e.g. exercise, nutrition, vitamin supplementation, kidney transplantation.	Acute effects of single dialysis sessions.
Comparator	A different intervention, placebo, control group or patients exposed to standard care ESRD management.	No restriction for comparators.
Outcome	Primary Outcome: Reduction in cf-PWV defined by pulse wave measurements on the carotid and femoral arteries using previously validated instrumentation and proper methodological technique. Secondary outcomes include a) reduction in systolic blood pressure and b) any reported serious or non-serious adverse events.	Studies that exclusively report on markers of arterial stiffness different from cf-PWV, such as brachial-ankle PWV, ankle-brachial index, augmentation index, carotid-brachial PWV and femoral-tibial PWV.
Study design	Randomized and non-randomized studies (cohort, case-control, single cohorts with before and after measurements) provided that 10 or more ESRD participants have received the intervention and its effects were assessed by cf-PWV.	Reviews, <i>in-vitro</i> studies, mathematical models, duplicates or “sub-cohorts” of previously published cohorts, research protocols, and reports that tested acute effects of single dialysis sessions on cf-PWV.
Language	English, French, Spanish, Italian	All other languages

CKD: chronic kidney disease; ESRD: end-stage renal disease; cf-PWV: carotid-femoral pulse wave velocity; e-GFR: estimated glomerular filtration rate; PWV: pulse wave velocity.

Supplementary Table S1. Quality of the evidence according to the **GRADE^s** methodology for the 2 outcomes in non-pharmacologic interventions.

Intervention	Study design	Risk of Bias[¶]	Inconsistency[¶]	Indirectness[¶]	Imprecision[¶]	Publication bias[¶]	Upgrading factors[£]	Quality of evidence
Carotid-Femoral Pulse Wave Velocity								
Kidney Transplant	Low quality	Serious risk (-1)	Serious (-1)	Not an issue	Not an issue	undetected	No upgrades	Very low quality (+)
Bio-impedance guided ultrafiltration	High quality	Serious risk (-1)	Serious (-1)	Not an issue	Serious (-1)	Undetected	Upgrade large effect (+1)	Low quality (++)
Normovolemia	Low quality	Serious risk (-1)	Not an issue	Not an issue	Serious (-1)	Undetected	Upgrade large effect (+1)	Very low quality (+)
Low Calcium dialysate	High quality	Serious risk (-1)	Not an issue	Not an issue	Serious (-1)	Undetected	Upgrade large effect (+1)	Moderate quality (+++)
Intra-dialytic Exercise	High quality	Serious risk (-1)	Serious (-1)	Not an issue	Serious (-1)	Undetected	Upgrade large effect (+1)	Low quality (++)
Systolic Blood Pressure								
Kidney Transplant	Low quality	Serious risk (-1)	Not an issue	Not an issue	Not an issue	undetected	No upgrades	Very low quality (+)
Bio-impedance guided ultrafiltration	High quality	Serious risk (-1)	Not an issue	Not an issue	Serious (-1)	Undetected	No upgrades	Low quality (++)

Intervention	Study design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Publication bias	Upgrading factors	Quality of evidence
Normovolemia	Low quality	Serious risk (-1)	Serious (-1)	Not an issue	Serious (-1)	Undetected	Upgrade large effect (+1)	Very low quality (+)
Low Calcium dialysate	High quality	Not an issue	Not an issue	Not an issue	Serious (-1)	Undetected	Upgrade large effect (+1)	Moderate quality (++++)
Intra-dialytic Exercise	High quality	Serious risk (-1)	Not an issue	Not an issue	Serious (-1)	Undetected	No upgrade	Low quality (++)

§GRADE starts with a baseline rating of HIGH for randomized trials and LOW for non-randomized studies. This baseline rating can then be adjusted (downgraded or upgraded) after considering 8 assessment criteria and making a judgment about quality based on these criteria. Ryan R, Hill S (2016). How to GRADE the quality of the evidence. Cochrane Consumers and Communication Group, available at <http://cccr.org/cochrane.org/author-resources>. Version 3.0 December 2016.

¶ Reasons to downgrade the evidence: Risk of bias, inconsistency, indirectness, imprecision and publication bias. For these 5 criteria: if no serious concern exists, the quality is not downgrade from the baseline quality (e.g. high for RCTs); if serious concern exists, downgrade the evidence one level, e.g. from high to moderate (-1); if very serious concern exists, downgrade the evidence two levels, e.g. from high to low (-2).

£ Reasons to upgrade the evidence: large magnitude of effect, dose response, or effect of all plausible confounding factors would be to reduce the effect (where an effect is observed) or suggest a spurious effect (when no effect is observed).

Supplementary Table S2. Summary of fatal and non-fatal adverse events reported for each intervention and comparator.

Paired intervention-comparator set		Intervention		Comparator	
Intervention	Comparator	All-cause deaths	Non-Fatal Adverse events	All-cause deaths	Non-Fatal Adverse events
Kidney transplant	Pre-transplant or dialysis therapy	5	Inter-current and non-specified events (n=7), re-transplantation (n=1), chronic rejection (n=1)	4	Dialysis-related peritonitis (n=11)
Bio-impedance guided ultrafiltration	Clinically-guided ultrafiltration	3	None	12	None
Normovolemia	Hypervolemia	0	Edema (n=2), rales (n=0); jugular vein distention (n=1)	0	Edema (n=11), rales (n=4), jugular vein distention (n=1)
Low calcium dialysate	High calcium dialysate	6	§Hypotension (n=2), muscle cramps, dizziness, nausea, vomiting and headache (n=7)	13	Calciphylaxis (n=1), hypercalcemia (n=1), cancer (n=1)
Intra-dialytic exercise	No exercise	0	Frequent cramps and tiredness (n=1)	1	None

§Intra-dialytic hypotension

Supplementary Table S3. Pre-treatment (baseline) values for carotid-femoral pulse wave velocity in participating populations from studies that assessed interventions that target aortic stiffness in end-stage renal disease.

Population (Intervention)	Baseline cf- PWV (m/s)	Population (Comparator)	Baseline cf- PWV (m/s)	Mean differences of the effect by the intervention on the cf-PWV (95% CI) relative to the comparator
Post-kidney transplant [#]	n/a	Pre-kidney transplant [#]	9.3 ± 2.3	-0.70 (-1.30, -0.11)
Cohort of Kidney recipients ^{&}	8.6 ± 2.0	Cohort of Dialysis patients ^{&}	8.8 ± 2.6	-0.67 (-1.38, 0.04)
Bio-impedance guided ultrafiltration [£]	8.4 ± 2.5	Clinically-guided ultrafiltration [£]	7.9 ± 2.1	-1.90 (-3.30, -0.50)
Normovolemia [¶]	9.3 ± 3.2	Hypervolemia [¶]	12.0 ± 3.4	-2.61 (-3.45,-1.76)
Low calcium dialysate [£]	10.6 ± 2.9	High calcium dialysate [£]	11.0 ± 3.0	-1.69 (-2.31, -1.07)
Intra-dialytic exercise [£]	9.9 ± 2.8	No exercise [£]	9.4 ± 2.8	-1.13 (-2.22, -0.03)

cf-PWV: carotid-femoral pulse wave velocity; [#] for single cohorts of kidney transplant recipients, baseline values correspond to measurement before (pre-transplant) transplantation; [&]for comparative cohort studies, baseline values at the time of enrollment are given for kidney recipients and dialysis groups; [¶]for cross-sectional studies, cf-PWV correspond to the single values reported; [£] for these interventions, baseline values correspond to the cf-PWV measurements before initiation of treatment.