

Supplemental Digital Content

SDC, Material and Methods, Appendix S1. Complete literature search strategy.

The first query consisted of the combination of 2 subjects: Normothermic Regional Perfusion and Transplantation with multiple synonyms. The search strategy was optimized for all consulted databases. For PubMed, a second, less specific query was compiled consisting of the combination of 2 subjects: Transplantation and Perfusion, both as major topics. Due to the unspecific character of this search, we excluded case reports, editorials and limited to articles published from 2013 onwards. Animal-only studies and reviews without original data were also excluded from this search. The final search was performed on the 29th of January 2020.

Database	Search Strategy First Query	Number of references	Number of unique references
PubMed (incl. MEDLINE)	("normothermic regional perfusion"[tw] OR "normothermic regional circulation"[tw] OR "normothermic recirculation"[tw] OR (("normothermic"[tw] OR normotherm*[tw] OR "normo-thermic"[tw] OR normo-therm*[tw]) AND ("NRP"[tw] OR "regional perfusion"[tw] OR "extracorporeal perfusion"[tw] OR "extra-corporeal perfusion"[tw] OR "extracorporeal membrane oxygenation"[tw] OR "extra-corporeal membrane oxygenation"[tw] OR "extracorporeal membranous oxygenation"[tw] OR "extra-corporeal membranous oxygenation"[tw] OR ("Perfusion"[mesh] OR "perfusion"[tw] OR perfus*[tw]) AND ("regional"[tw] OR regional*[tw])) OR "recirculation"[tw] OR recirculat*[tw] OR "regional circulation"[tw] OR "novel perfusion system"[tw] OR "novel perfusion technique"[tw] OR "new perfusion method"[tw] OR "new perfusion system"[tw] OR "new perfusion technique"[tw] OR ("shift"[tw] AND "organ perfusion"[tw])) AND ("Transplants"[Mesh] OR transplant*[all fields] OR "transplants"[all fields] OR "transplantation"[all fields] OR graft*[tw] OR organ transplant*[tw] OR organ graft*[tw] OR "Transplantation"[Mesh] OR "deceased donors"[tw] OR "deceased donor"[tw] OR "DCD donors"[tw] OR "DCD donor"[tw] OR "dcd organ donors"[tw] OR "deceased kidney donor"[tw] OR "deceased kidney donors"[tw] OR "deceased liver donor"[tw] OR "deceased liver donors"[tw] OR "deceased heart beating donor"[tw] OR "deceased heart beating donors"[tw] OR "dcd"[tw] OR "donation after circulatory death"[tw] OR "donation after cardiac death"[tw] OR "donation after cardiocirculatory death"[tw] OR "donation after cardio circulatory death"[tw] OR "non heart beating donor"[tw] OR "non heart beating donors"[tw] OR	253 regular references	229 regular references

	"nonheart beating donor"[tw] OR "nonheart beating donors"[tw] OR "Circulatory Death"[tw] AND (uncontrolled donat*[tw] OR uncontrolled organ don*[tw] OR uncontrolled donor*[tw]))		
Embase (OVID-version)	("normothermic regional perfusion".mp OR "normothermic regional circulation".mp OR "normothermic recirculation".mp OR (((("normothermic".mp OR normotherm*.mp OR "normo-thermic".mp OR normo-therm*.mp) AND ("NRP".mp OR "regional perfusion".mp OR "extracorporeal perfusion".mp OR "extra-corporeal perfusion".mp OR "extracorporeal membrane oxygenation".mp OR "extra-corporeal membrane oxygenation".mp OR "extracorporeal membranous oxygenation".mp OR "extra-corporeal membranous oxygenation".mp OR ((exp "Perfusion"/ OR "Regional Perfusion"/ OR "perfusion".mp OR perfus*.mp) AND ("regional".mp OR regional*.mp)) OR "recirculation".mp OR recirculat*.mp OR "regional circulation".mp) OR "novel perfusion system".mp OR "novel perfusion technique".mp OR "new perfusion method".mp OR "new perfusion system".mp OR "new perfusion technique".mp OR ("shift".mp AND "organ perfusion".mp)) AND (exp "Transplantation"/ OR transplant*.af OR "transplants".af OR "transplantation".af OR graft*.mp OR organ transplant*.mp OR organ graft*.mp OR "deceased donors".mp OR "deceased donor".mp OR "DCD donors".mp OR "DCD donor".mp OR "dcd organ donors".mp OR "deceased kidney donor".mp OR "deceased kidney donors".mp OR "deceased liver donor".mp OR "deceased liver donors".mp OR "deceased heart beating donor".mp OR "deceased heart beating donors".mp OR "dcd".mp OR "donation after circulatory death".mp OR "donation after cardiac death".mp OR "donation after cardiocirculatory death".mp OR "donation after cardio circulatory death".mp OR "Circulatory Death" AND ("uncontrolled donat*" OR "uncontrolled organ don*" OR "uncontrolled donor*").mp)))	270 regular references	55 regular references
Web of Science	TS=(("normothermic regional perfusion" OR "normothermic regional circulation" OR "normothermic recirculation" OR (((("normothermic" OR normotherm* OR "normo-thermic" OR normo-therm*) AND ("NRP" OR "regional perfusion" OR "extracorporeal perfusion" OR "extra-corporeal perfusion" OR "extracorporeal membrane oxygenation" OR "extra-corporeal membrane oxygenation" OR "extracorporeal membranous oxygenation" OR "extra-corporeal membranous oxygenation" OR ("Perfusion" OR perfus*) AND ("regional" OR regional*)) OR "recirculation" OR recirculat* OR "regional circulation") OR "novel perfusion system" OR "novel perfusion technique" OR "new perfusion method" OR "new perfusion system" OR "new perfusion technique" OR ("shift" AND "organ perfusion")) AND ("Transplantation" OR transplant* OR graft* OR "deceased donors" OR "deceased donor" OR "DCD donors" OR "DCD donor" OR "dcd organ donors" OR "deceased kidney donor" OR "deceased kidney donors" OR "deceased liver donor" OR "deceased liver donors" OR "deceased heart beating donor" OR "deceased heart beating donors" OR "dcd" OR "donation after circulatory death" OR "donation after cardiac death"	273 regular references	96 regular reference

	OR "donation after cardiocirculatory death" OR "donation after cardio circulatory death" OR "Circulatory Death" AND ("uncontrolled donat*" OR "uncontrolled organ don*" OR "uncontrolled donor*"))		
Cochrane Library	("normothermic regional perfusion" OR "normothermic regional circulation" OR "normothermic recirculation" OR (((("normothermic" OR normotherm* OR "normo-thermic" OR normo-therm*) AND ("NRP" OR "regional perfusion" OR "extracorporeal perfusion" OR "extra-corporeal perfusion" OR "extracorporeal membrane oxygenation" OR "extra-corporeal membrane oxygenation" OR "extracorporeal membranous oxygenation" OR "extra-corporeal membranous oxygenation" OR ("Perfusion" OR perfus*) AND ("regional" OR regional*)) OR "recirculation" OR recirculat* OR "regional circulation") OR "novel perfusion system" OR "novel perfusion technique" OR "new perfusion method" OR "new perfusion system" OR "new perfusion technique" OR ("shift" AND "organ perfusion")) AND ("Transplantation" OR transplant* OR graft* OR "deceased donors" OR "deceased donor" OR "DCD donors" OR "DCD donor" OR "dcd organ donors" OR "deceased kidney donor" OR "deceased kidney donors" OR "deceased liver donor" OR "deceased liver donors" OR "deceased heart beating donor" OR "deceased heart beating donors" OR "dcd" OR "donation after circulatory death" OR "donation after cardiac death" OR "donation after cardiocirculatory death" OR "donation after cardio circulatory death" OR "Circulatory Death" AND ("uncontrolled donat*" OR "uncontrolled organ don*" OR "uncontrolled donor*"))):ti,ab,kw	8 regular references	0 regular references
Emcare	("normothermic regional perfusion".mp OR "normothermic regional circulation".mp OR "normothermic recirculation".mp OR (((("normothermic".mp OR normotherm*.mp OR "normo-thermic".mp OR normo-therm*.mp) AND ("NRP".mp OR "regional perfusion".mp OR "extracorporeal perfusion".mp OR "extra-corporeal perfusion".mp OR "extracorporeal membrane oxygenation".mp OR "extra-corporeal membrane oxygenation".mp OR "extracorporeal membranous oxygenation".mp OR "extra-corporeal membranous oxygenation".mp OR (exp "Perfusion"/ OR "Regional Perfusion"/ OR "perfusion".mp OR perfus*.mp) AND ("regional".mp OR regional*.mp)) OR "recirculation".mp OR recirculat*.mp OR "regional circulation".mp) OR "novel perfusion system".mp OR "novel perfusion technique".mp OR "new perfusion method".mp OR "new perfusion system".mp OR "new perfusion technique".mp OR ("shift".mp AND "organ perfusion".mp)) AND (exp "Transplantation"/ OR transplant*.af OR "transplants".af OR "transplantation".af OR graft*.mp OR organ transplant*.mp OR organ graft*.mp OR "deceased donors".mp OR "deceased donor".mp OR "DCD donors".mp OR "DCD donor".mp OR "dcd organ donors".mp OR "deceased kidney donor".mp OR "deceased kidney donors".mp OR "deceased liver donor".mp OR "deceased liver donors".mp OR "deceased heart beating donor".mp OR "deceased heart beating donors".mp OR "dcd".mp OR "donation after circulatory death".mp OR "donation after cardiac death".mp OR "donation after cardiocirculatory death".mp OR "donation after cardio circulatory death".mp OR "Circulatory Death"	84 regular references	2 regular references

	AND ("uncontrolled donat** OR "uncontrolled organ don** OR "uncontrolled donor**").mp)))		
Academic Search Premier	TI("normothermic regional perfusion" OR "normothermic regional circulation" OR "normothermic recirculation" OR (((("normothermic" OR normotherm* OR "normo-thermic" OR normo-therm*) AND ("NRP" OR "regional perfusion" OR "extracorporeal perfusion" OR "extra-corporeal perfusion" OR "extracorporeal membrane oxygenation" OR "extra-corporeal membrane oxygenation" OR "extracorporeal membranous oxygenation" OR "extra-corporeal membranous oxygenation" OR ("Perfusion" OR perfus*) AND ("regional" OR regional*)) OR "recirculation" OR recirculat* OR "regional circulation") OR "novel perfusion system" OR "novel perfusion technique" OR "new perfusion method" OR "new perfusion system" OR "new perfusion technique" OR ("shift" AND "organ perfusion")) AND ("Transplantation" OR transplant* OR graft* OR "deceased donors" OR "deceased donor" OR "DCD donors" OR "DCD donor" OR "dcd organ donors" OR "deceased kidney donor" OR "deceased kidney donors" OR "deceased liver donor" OR "deceased liver donors" OR "deceased heart beating donor" OR "deceased heart beating donors" OR "dcd" OR "donation after circulatory death" OR "donation after cardiac death" OR "donation after cardiocirculatory death" OR "donation after cardio circulatory death" OR "non heart beating donor" OR "non heart beating donors" OR "nonheart beating donor" OR "nonheart beating donors")))) OR SU("normothermic regional perfusion" OR "normothermic regional circulation" OR "normothermic recirculation" OR (((("normothermic" OR normotherm* OR "normo-thermic" OR normo-therm*) AND ("NRP" OR "regional perfusion" OR "extracorporeal perfusion" OR "extra-corporeal perfusion" OR "extracorporeal membrane oxygenation" OR "extra-corporeal membrane oxygenation" OR "extracorporeal membranous oxygenation" OR "extra-corporeal membranous oxygenation" OR ("Perfusion" OR perfus*) AND ("regional" OR regional*)) OR "recirculation" OR recirculat* OR "regional circulation") OR "novel perfusion system" OR "novel perfusion technique" OR "new perfusion method" OR "new perfusion system" OR "new perfusion technique" OR ("shift" AND "organ perfusion")) AND ("Transplantation" OR transplant* OR graft* OR "deceased donors" OR "deceased donor" OR "DCD donors" OR "DCD donor" OR "dcd organ donors" OR "deceased kidney donor" OR "deceased kidney donors" OR "deceased liver donor" OR "deceased liver donors" OR "deceased heart beating donor" OR "deceased heart beating donors" OR "dcd" OR "donation after circulatory death" OR "donation after cardiac death" OR "donation after cardiocirculatory death" OR "donation after cardio circulatory death" OR "non heart beating donor" OR "non heart beating donors" OR "nonheart beating donor" OR "nonheart beating donors")))) OR KW("normothermic regional perfusion" OR "normothermic regional circulation" OR "normothermic recirculation" OR (((("normothermic" OR normotherm* OR "normo-thermic" OR normo-therm*) AND ("NRP" OR "regional perfusion" OR "extracorporeal perfusion" OR "extra-corporeal perfusion" OR "extracorporeal membrane oxygenation" OR "extra-corporeal membrane oxygenation" OR "extracorporeal membranous oxygenation" OR "extra-corporeal membranous oxygenation" OR ("Perfusion" OR	118 regular references	25 regular references

	<p>perfus*) AND ("regional" OR regional*)) OR "recirculation" OR recirculat* OR "regional circulation") OR "novel perfusion system" OR "novel perfusion technique" OR "new perfusion method" OR "new perfusion system" OR "new perfusion technique" OR ("shift" AND "organ perfusion")) AND ("Transplantation" OR transplant* OR graft* OR "deceased donors" OR "deceased donor" OR "DCD donors" OR "DCD donor" OR "dcd organ donors" OR "deceased kidney donor" OR "deceased kidney donors" OR "deceased liver donor" OR "deceased liver donors" OR "deceased heart beating donor" OR "deceased heart beating donors" OR "dcd" OR "donation after circulatory death" OR "donation after cardiac death" OR "donation after cardiocirculatory death" OR "donation after cardio circulatory death" OR "non heart beating donor" OR "non heart beating donors" OR "nonheart beating donor" OR "nonheart beating donors")) OR AB("normothermic regional perfusion" OR "normothermic regional circulation" OR "normothermic recirculation" OR (((("normothermic" OR normotherm* OR "normo-thermic" OR normo-therm*) AND ("NRP" OR "regional perfusion" OR "extracorporeal perfusion" OR "extra-corporeal perfusion" OR "extracorporeal membrane oxygenation" OR "extra-corporeal membrane oxygenation" OR "extracorporeal membranous oxygenation" OR "extra-corporeal membranous oxygenation" OR ("Perfusion" OR perfus*) AND ("regional" OR regional*)) OR "recirculation" OR recirculat* OR "regional circulation") OR "novel perfusion system" OR "novel perfusion technique" OR "new perfusion method" OR "new perfusion system" OR "new perfusion technique" OR ("shift" AND "organ perfusion")) AND ("Transplantation" OR transplant* OR graft* OR "deceased donors" OR "deceased donor" OR "DCD donors" OR "DCD donor" OR "dcd organ donors" OR "deceased kidney donor" OR "deceased kidney donors" OR "deceased liver donor" OR "deceased liver donors" OR "deceased heart beating donor" OR "deceased heart beating donors" OR "dcd" OR "donation after circulatory death" OR "donation after cardiac death" OR "donation after cardiocirculatory death" OR "donation after cardio circulatory death" OR "non heart beating donor" OR "non heart beating donors" OR "nonheart beating donor" OR "nonheart beating donors" OR ("Circulatory Death" AND ("uncontrolled donat*" OR "uncontrolled organ don*" OR "uncontrolled donor*")) OR SU("Circulatory Death" AND ("uncontrolled donat*" OR "uncontrolled organ don*" OR "uncontrolled donor*")) OR KW("Circulatory Death" AND ("uncontrolled donat*" OR "uncontrolled organ don*" OR "uncontrolled donor*")) OR AB("Circulatory Death" AND ("uncontrolled donat*" OR "uncontrolled organ don*" OR "uncontrolled donor*"))))</p>		
Science Direct	TITLE-ABSTR-KEY("normothermic regional perfusion" OR "normothermic regional circulation" OR "normothermic recirculation")	19 regular references	9 regular references
Google Scholar	title:"normothermic regional perfusion" "normothermic regional circulation" "normothermic recirculation"	105 regular references	69 regular references

Database	Search Strategy Second Query	Number of references	Number of unique references
PubMed (incl. MEDLINE)	(("Transplants"[majr] OR transplant*[ti] OR graft*[ti] OR organ transplant*[ti] OR organ graft*[ti] OR "Transplantation"[majr] OR "deceased donors"[tw] OR "deceased donor"[tw] OR "DCD donors"[tw] OR "DCD donor"[tw] OR "dcd organ donors"[tw] OR "deceased kidney donor"[tw] OR "deceased kidney donors"[tw] OR "deceased liver donor"[tw] OR "deceased liver donors"[tw] OR "deceased heart beating donor"[tw] OR "deceased heart beating donors"[tw] OR "dcd"[tw] OR "donation after circulatory death"[tw] OR "donation after cardiac death"[tw] OR "donation after cardiocirculatory death"[tw] OR "donation after cardio circulatory death"[tw]) AND ("Perfusion"[majr] OR "Perfusion"[ti] OR "normothermic regional perfusion"[tw] OR "normothermic recirculation"[tw] OR "abdominal regional perfusion"[tw] OR "Extracorporeal Membrane Oxygenation"[Mesh] OR "extracorporeal membrane oxygenation"[tw] OR "ECMO"[tw] OR "Reperfusion"[ti]) NOT ("case reports"[ptyp] OR "case report"[ti] OR "comment"[ptyp] OR "comment"[ti] OR "letter"[ptyp] OR "letter"[ti] OR "editorial"[ptyp] OR "editorial"[ti]) AND ("2013/01/01"[PDAT] : "3000/12/31"[PDAT]) NOT ("Coronary Artery Bypass"[majr] OR "Coronary bypass"[ti] OR "coronary bypasses"[ti] OR "Coronary Artery Bypass"[ti] OR "coronary artery bypasses"[ti] OR "Ischemia"[majr] OR "Ischemia"[ti] OR "Ischaemia"[ti] OR ischemi*[ti] OR ischaemi*[ti] OR "Reperfusion"[majr] OR "reperfusion"[ti] OR reperfus*[ti] OR "bridge to lung transplantation"[ti] OR "bridge to lung transplant"[ti] OR "bridge"[ti] OR bridg*[ti]))	1.120 regular references	1.073 regular references
Total		2.250 regular references	1.558 unique regular references

SDC, Material and Methods; Table S1. Data extraction variables.	
Study characteristics	Name of the first author, publication year, study design, location, study period and follow-up
Study population characteristics	Samples size, donor type according to the Modified Maastricht Classification for DCD, donor selection criteria, donor age, recipient age, organs donated
Transplantation data	Donor WIT, aNRP time, temperature, flow rates, CIT, interventions performed before declaration of death, no touch period
Primary outcomes	Organ utilization, patient and graft survival at 1 year
Secondary outcomes	Kidney: PNF, DGF, sCr, eGFR or mGFR Liver: PNF, Biliary complications, IC, EAD Pancreas: yield after islet isolation
aNRP, abdominal Normothermic Regional Perfusion; CIT, Cold Ischemia Time; DCD, Donation after Circulatory Death; DGF, Delayed Graft Function; EAD, Early Allograft Dysfunction; eGFR, estimated Glomerular Filtration Rate; IC, Ischemic Cholangiopathy; mGFR, measured Glomerular Filtration Rate; PNF, Primary Nonfunction; sCr, Serum Creatinine; WIT, Warm Ischemia Time.	

SDC, Material and Methods; Table S2. Risk of Bias judgments for the 7 domains in the ROBINS-I tool²³ specified for the subject of this review.

Overall judgment for each of the 7 domains.	
Low risk of bias	<i>The study is comparable to a well-performed randomized trial with regard to this domain.</i>
Moderate risk of bias	<i>The study is sound for a nonrandomized study with regard to this domain but cannot be considered comparable to a well-performed randomized trial.</i>
Serious risk of bias	<i>The study has some important problems.</i>
Critical risk of bias	<i>The study is too problematic to provide any useful evidence on the effects of intervention.</i>
No information	<i>On which to base a judgement about risk of bias for this domain.</i>

Domain. Bias due to confounding	
Low risk of bias	No confounding expected
Moderate risk of bias	Confounding expected. Important confounding domains (eg, donor age, donor type) appropriately measured and controlled for (propensity score matching, stratification, regression, standardization).
Serious risk of bias	At least 1 known important domain (eg, donor age, donor type) not controlled for.
Critical risk of bias	Confounding inherently not controllable (no baseline characteristics reported the study).

Domain. Bias in selection of participants into the study	
Low risk of bias	All participants who would have been eligible were included in the study.
Moderate risk of bias	Selection (eg, gender or age in donor and recipient, duration fWIT or duration aNRP) may have been related to intervention and outcome but appropriate methods to adjust were used (eg, nearest neighbour matching algorithm).
Serious risk of bias	Selection (eg, gender or age in donor and recipient, duration fWIT or duration aNRP) have been related to intervention and outcome and this could not be adjusted for in analyses.
Critical risk of bias	Selection into study was very strongly related to intervention and outcome and this could not be adjusted for in analyses.

Domain. Bias in classification of intervention	
Low risk of bias	Status of aNRP or standard perfusion technique is well defined and data was prospectively collected.
Moderate risk of bias	Status of aNRP or standard perfusion technique is well defined but the assignments of intervention status was determined retrospectively.
Serious risk of bias	Status of aNRP or standard perfusion technique is not well defined.

Critical risk of bias	An extremely high amount of misclassification of intervention status.
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Domain. Bias due to deviations from intended interventions	
Low risk of bias	Deviations from intended intervention reflected usual practice and were unlikely to impact on the outcome.
Moderate risk of bias	Deviations from intended intervention reflected usual practice but their impact on the outcome is expected to be slight (eg, CIT, immunosuppression, end-ischemic ex situ machine perfusion).
Serious risk of bias	Deviations were unbalanced between the intervention groups and likely to have affected the outcome (eg, end-ischemic ex-situ machine perfusion).
Critical risk of bias	Substantial deviations that were unbalanced between intervention groups and likely to have affected the outcome.

Domain. Bias due to missing data	
Low risk of bias	Data were reasonably complete ($\pm 10\%$) or proportions of and reasons for missing participants were similar across intervention groups.
Moderate risk of bias	Proportion of and reasons for missing participants differ slightly across intervention groups.
Serious risk of bias	Proportion of and reasons for missing participants differ substantially across intervention groups.
Critical risk of bias	Critical differences between interventions in participants with missing data were observed and were not or could not be addressed through appropriate analysis.

Domain. Bias in measurement of outcomes	
Low risk of bias	Comparable methods of outcome assessment across intervention groups, and outcome measure was unlikely to be influenced by knowledge of the intervention received by study participants and any error in measuring the outcome is unrelated to intervention status. Eg, patient survival, graft survival, PNF, DGF.
Moderate risk of bias	Comparable methods of outcome assessment across intervention groups, outcome measure is only minimally influenced by knowledge of the intervention and any error is minimally related to intervention status (eg, image proven or clinical ischemic cholangiopathy).
Serious risk of bias	Not comparable methods of outcome assessment across intervention groups.
Critical risk of bias	Different methods of outcome assessment that cannot reasonably be compared across intervention groups.

Domain. Bias in selection of the reported results	
Low risk of bias	Clear evidence (via a preregistered protocol or statistical analysis plan) that all reported results correspond to all intended outcomes, analyses and subcohorts.
Moderate risk of bias	Outcome measurements and analyses are consistent with an a priori plan and no indication of selection of the reported analysis from

	among multiple analyses and no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.
Serious risk of bias	High risk of selective reporting from among multiple analyses (eg, exclusion of PNF or exclusion of one participating center).
Critical risk of bias	Evidence or strong suspicion of selective reporting of results and unreported results are likely to be substantially different from the reported results.

Abbreviations: aNRP, abdominal Normothermic Regional Perfusion; CIT, Cold Ischemia Time; DGF, Delayed Graft Function; fWIT, functional Warm Ischemia Time; PNF, Primary Nonfunction.

References:

1. Sterne JA, Hernan MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. *BMJ*. 2016;355:i4919. doi:10.1136/bmj.i4919