Resipher
LUCID SCIENTIFIC

WHITE PAPER

Vascular cells never stop respiring.
Most metabolic measurements only look once.

Endothelial cells, smooth muscle cells, and pericytes change their metabolism on the timescale of hours and days, in response to flow, hypoxia, inflammation, and phenotype switching. Continuous oxygen consumption rate monitoring inside the incubator makes that entire progression measurable in standard 96-well plates, without touching the cells.

AT A GLANCE

Days
to weeks of uninterrupted respiration data from a single plate

96
standard wells, no specialized consumables or plate format

0
plate transfers, media swaps, dyes, or reagent additions required

Runs in the incubator or a hypoxia chamber

The sensing lid sits on the plate at physiological temperature, humidity, and CO_2, or inside a hypoxic chamber or oxygen-controlled workstation at a set oxygen tension. Cells are never moved to an analyzer.

Non-invasive and label-free

No fluorescent dyes and no assay media swap. Cells remain available for imaging, sequencing, or any downstream endpoint after the run.

2D and 3D formats

Monolayers, spheroids, organoids, and zebrafish embryos. Probe length options accommodate different geometries.

Relevance of live mitochondrial respiration in vascular cells

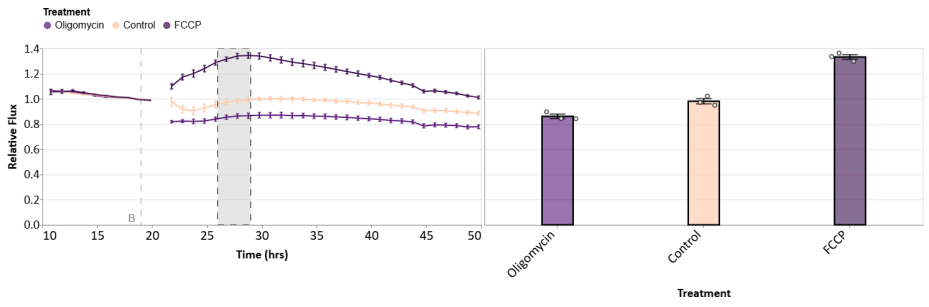
Endothelial cells and pericytes are not primarily oxidative cells, and a large share of the vascular metabolic literature has focused on glycolysis. Smooth muscle cells are a different case: contractile VSMCs rely substantially on oxidative phosphorylation, and the shift toward glycolysis is part of the synthetic transition itself. In all three, mitochondrial respiration is informative and changes with inflammatory activation, oxygen tension, phenotype switching, and differentiation state.

The biology of interest unfolds over hours to days. Flow adaptation, hypoxic response, differentiation, phenotype switching, and drug washout are all progressions, not single states. Yet the standard functional readout for respiration is an endpoint assay: cells come out of the incubator, move to an analyzer, sit in an assay medium they were not cultured in, and report roughly twenty minutes of their life. The experiment ends there, and so does the plate.

> **The core question:** when the metabolic behavior you care about takes days to emerge, a single endpoint reading captures one moment of it. What would you see if you could watch the same wells continuously across the whole progression, and still run an endpoint assay when you want one?

BIOENERGETIC PROFILING IN VASCULAR SMOOTH MUSCLE CELLS

Relative OCR, each well normalized to its own pre-treatment baseline



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Where continuous OCR has been published

Two peer-reviewed publications using Resipher with human vascular cells, coronary artery endothelial and smooth muscle cells and brain microvascular endothelial cells. Both follow oxygen consumption in the incubator across hours to days rather than at a single time point.

CORONARY ARTERY EC & SMC

Oxygen consumption in primary human coronary endothelial and smooth muscle cells across oxygen tensions

Smith, Yang, and colleagues (Mann group, King's College London) measured basal oxygen consumption rate in primary human coronary artery endothelial and smooth muscle cells adapted to standard culture oxygen (18 kPa, which the authors term hyperoxia), physiological normoxia (5 kPa), and hypoxia (1 kPa), with the plate inside an oxygen-controlled workstation. Relevance: OCR recorded in these cell types under different oxygen levels. Open access (ref. 1).

BRAIN MICROVASCULAR EC

Oxygen consumption across iPSC-derived brain microvascular endothelial cell lines

Crockett and colleagues (Alvarez and Anderson groups, University of Pennsylvania and Children's Hospital of Philadelphia) followed oxygen consumption continuously across iPSC-derived brain microvascular endothelial cell (iBMEC) lines from individuals with 22q11.2 deletion syndrome and matched healthy controls, resolving a mitochondrial deficit that tracked with barrier integrity. Relevance: barrier endothelium is mitochondria-rich, and the phenotype emerged over days rather than in a single reading (ref. 2).

Where this format fits in vascular work

These are directions rather than claims. The first three are questions the vascular metabolism literature is actively asking; the rest are applications where the study design recurs in vascular work.

TOPIC	WHY CONTINUOUS MEASUREMENT FITS
Endothelial activation and inflammation	Inflammatory activation has an onset, a peak, and a resolution phase. Continuous measurement captures when the response begins and whether it resolves.
Smooth muscle phenotype switching	The contractile to synthetic transition unfolds over days. Following the same wells across the switch avoids reconstructing a progression from separate endpoint plates.
Hypoxia and reoxygenation	The response to an oxygen manipulation and the recovery afterward are two different measurements, and recovery requires that the culture survive the first intact. The plate can sit inside a hypoxic chamber or oxygen-controlled workstation at a set oxygen tension (ref. 1).
Vascularized organoids and 3D constructs	An application rather than an open question. Maturation is the variable of interest, and continuous respiration gives a non-destructive readout across the build, with probe length options for different 3D geometries.
Zebrafish embryos	Vessel development unfolds over days, and embryos sit in the same 96-well format in static media, followed continuously rather than at one stage.
Drug response, washout, and recovery	A study design point that applies wherever cells are dosed, vascular included. Whether an effect is transient or durable, and whether it reverses on washout, cannot be established from a single time point.

REFERENCES

Full publication list, including studies added since this paper was prepared, is maintained at **lucidsci.com/resources#publications**.

1. Smith M.J., Yang F., Griffiths A., Morrell A., Chapple S.J., Siow R.C.M., Stewart T., Maret W., Mann G.E. (2023). Redox and metal profiles in human coronary endothelial and smooth muscle cells under hyperoxia, physiological normoxia and hypoxia. Redox Biology 62:102712. DOI: 10.1016/j.redox.2023.102712.

2. Crockett A.M., Velez Colon M.C., Kebir H., Smith F.M., Iascone D.M., Ciesielski B., Koshkin S., Patterson A.D., Rossano A.J., Sehgal A., Anderson S.A., Alvarez J.I. (2025). Bezafibrate improves mitochondrial function, blood-brain barrier integrity, and social deficits in models of 22q11.2 deletion syndrome. Science Translational Medicine 17(812):eads2116. DOI: 10.1126/scitranslmed.ads2116.

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Asilomar, Pacific Grove, CA, October 18-22. Tell us which vascular models you work in and what your metabolic readout currently misses.

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