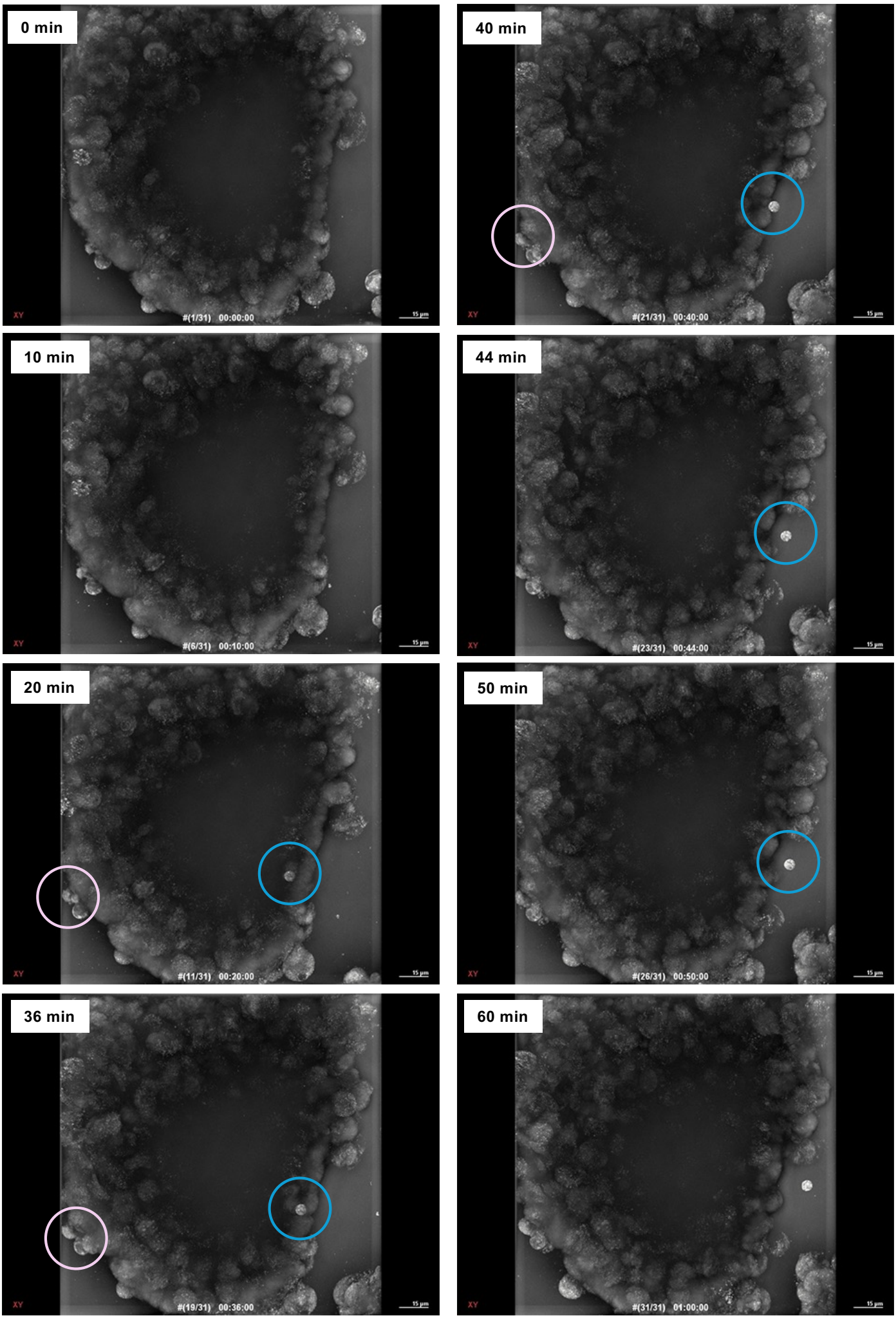
Supplemental Information

Label-free holotomography reveals dynamic structural remodeling in living pancreatic islets

Naoaki Sakata, Ryo Kawakami, Teppei Yamada, Gumpei Yoshimatsu, Shohta Kodama

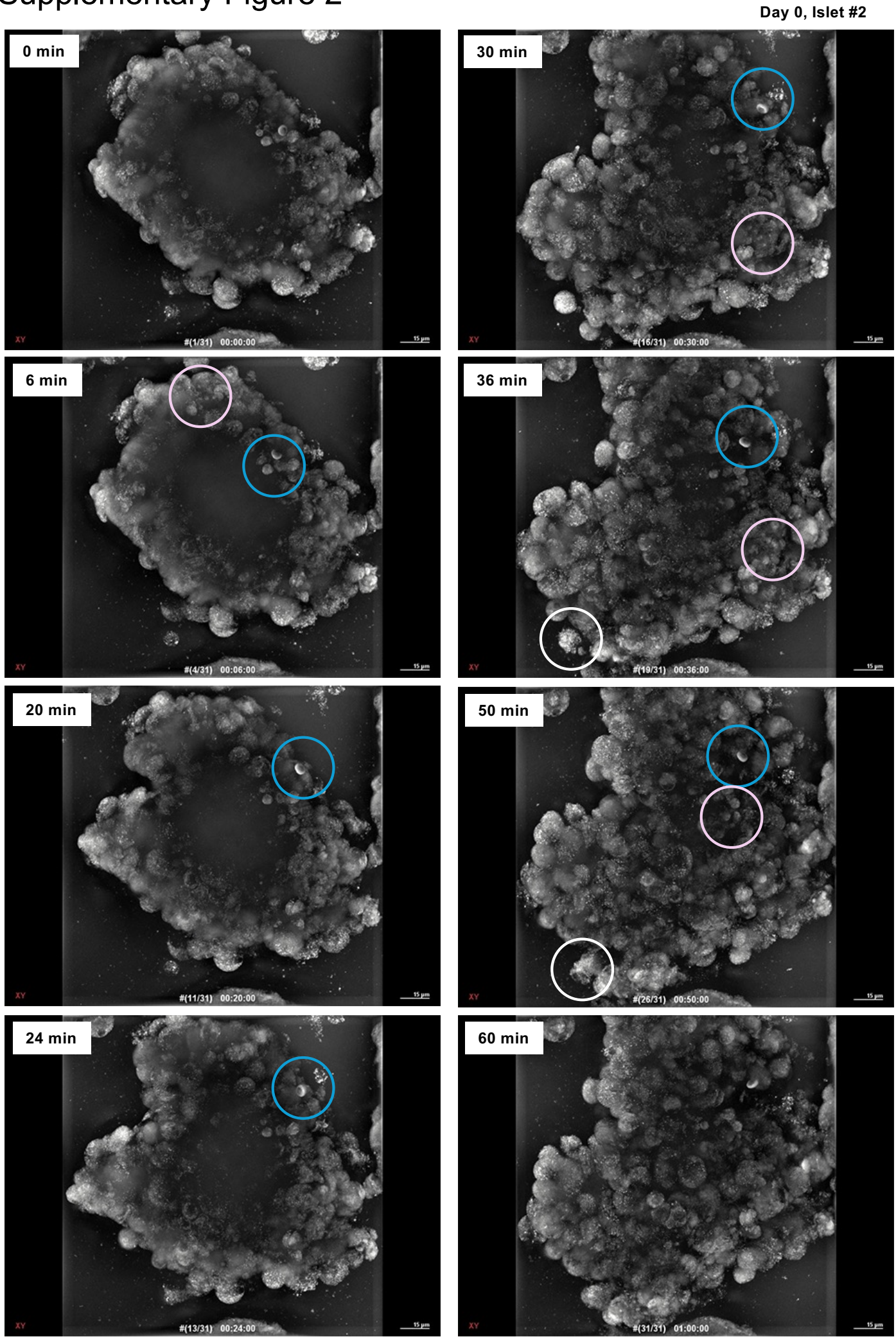
Supplementary Figure 1



Supplementary Figure 1. Snapshots of No. 1 islet on Day 0 during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. Blue circles indicate a nuclear- or nuclear-remnant-like structure, and purple circles indicate a blebbing cell. The scale bar represents 15 μm.

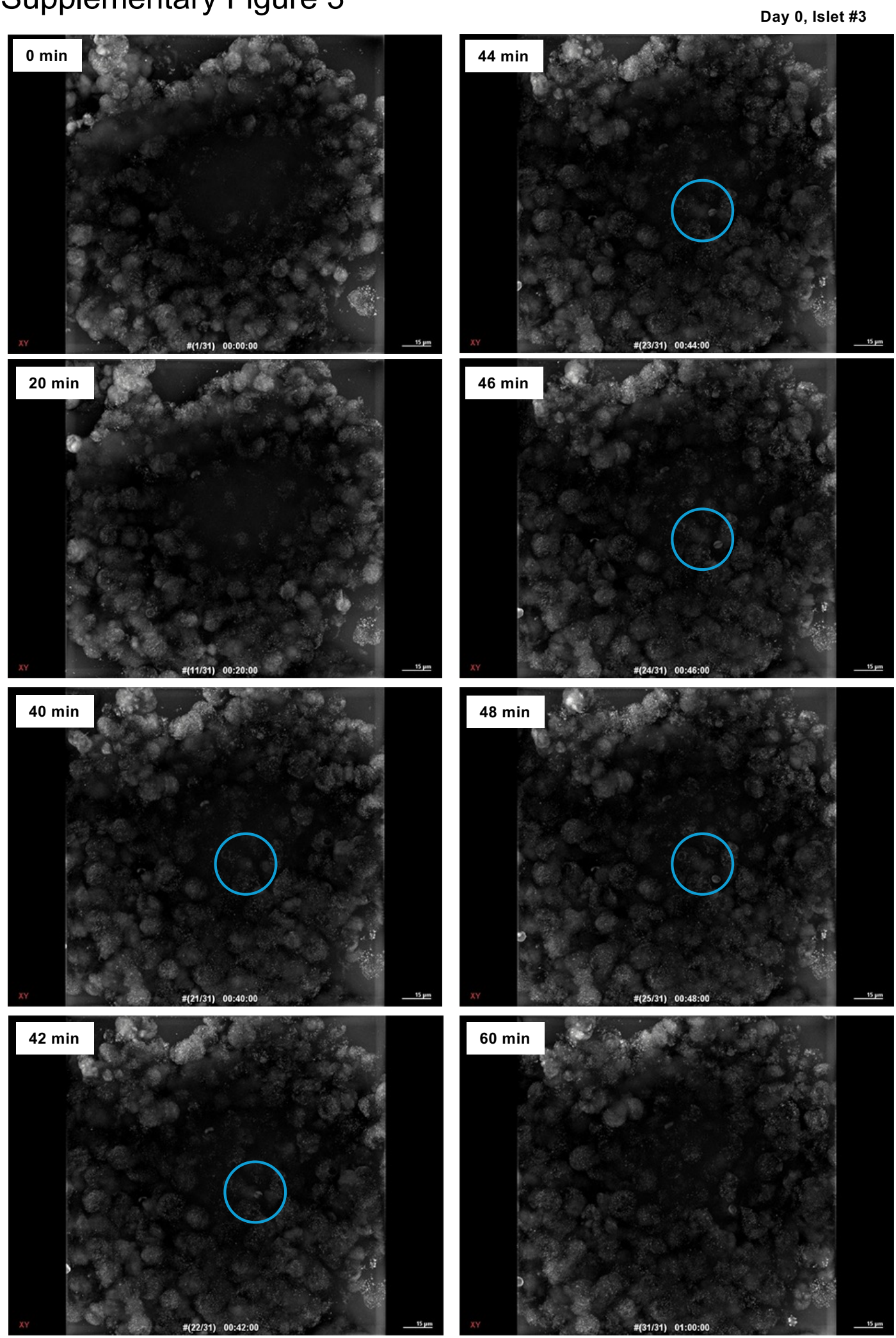
Supplementary Figure 2



Supplementary Figure 2. Snapshots of No. 2 islet on Day 0 during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. White circles indicate a ruptured cell, blue circles indicate a nuclear- or nuclear-remnant-like structure, and purple circles indicate a blebbing cell. The scale bar represents 15 μm.

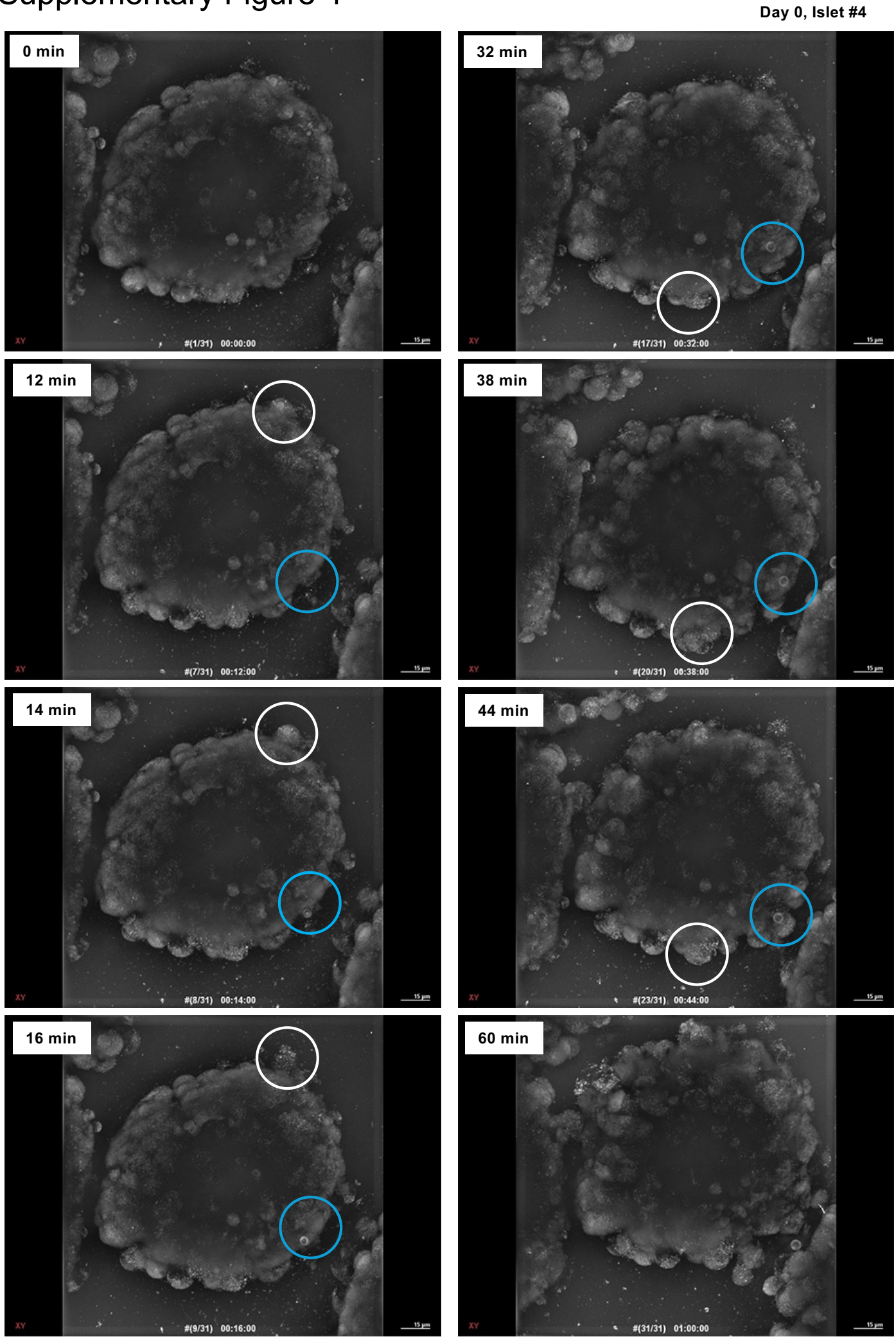
Supplementary Figure 3



Supplementary Figure 3. Snapshots of No. 3 islet on Day 0 during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. Blue circle indicates a nuclear- or nuclear-remnant-like structure. The scale bar represents 15 μm.

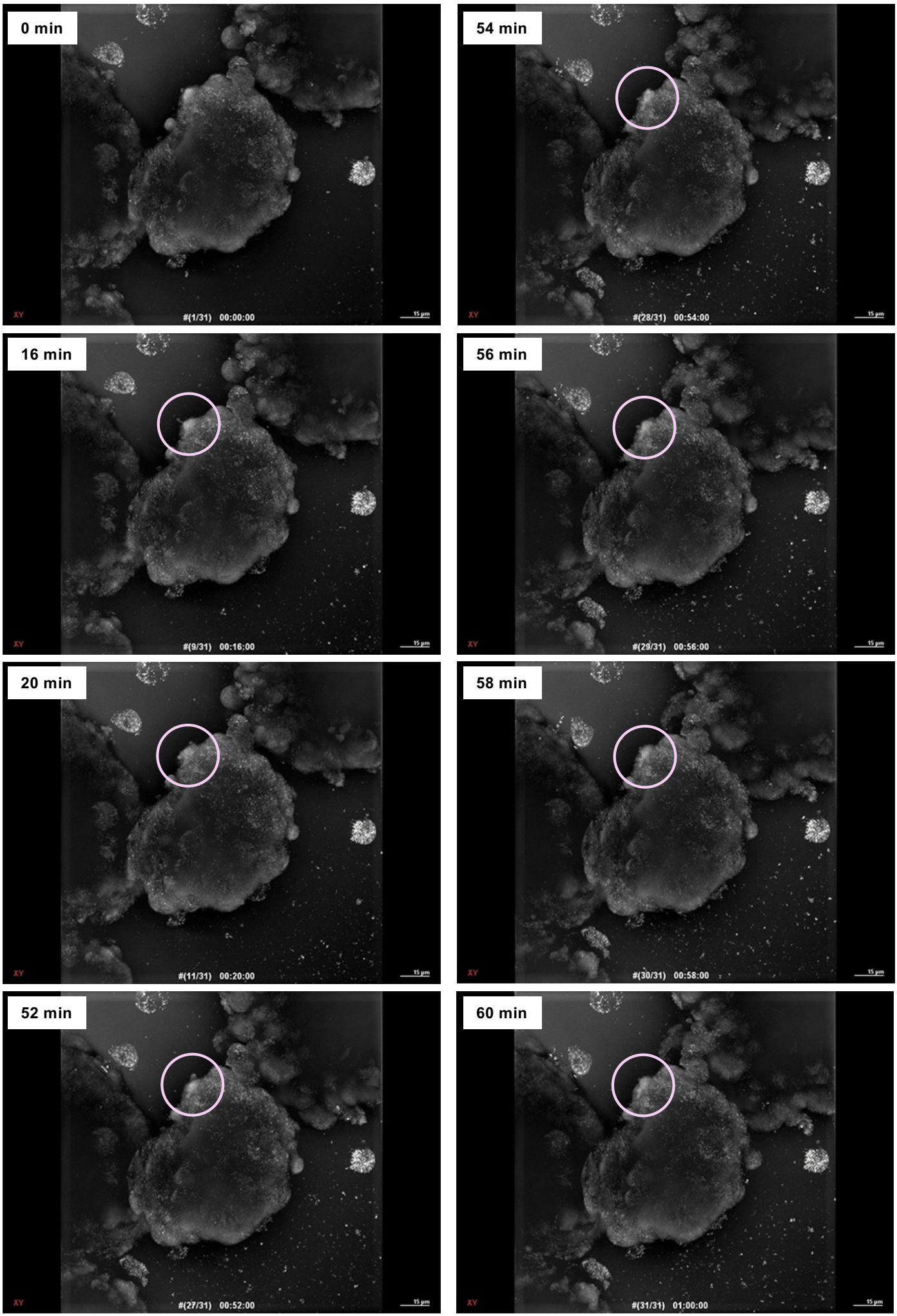
Supplementary Figure 4



Supplementary Figure 4. Snapshots of No. 4 islet on Day 0 during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. Blue circles indicate a nuclear- or nuclear-remnant-like structure, and purple circles indicate a blebbing cell. The scale bar represents 15 μm.

Supplementary Figure 5

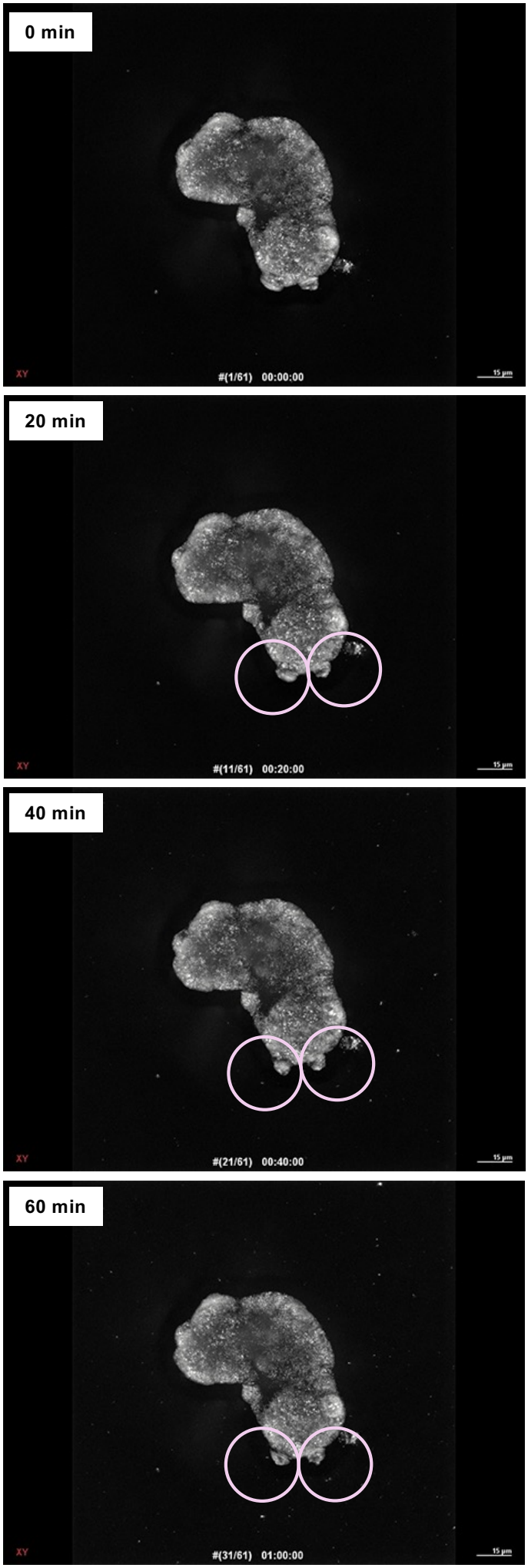


Supplementary Figure 5. Snapshots of No. 5 islet on Day 0 during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. The purple circle indicates a blebbing cell. The scale bar represents 15 μm.

Supplementary Figure 6

Day 2 24℃ , Islet #1

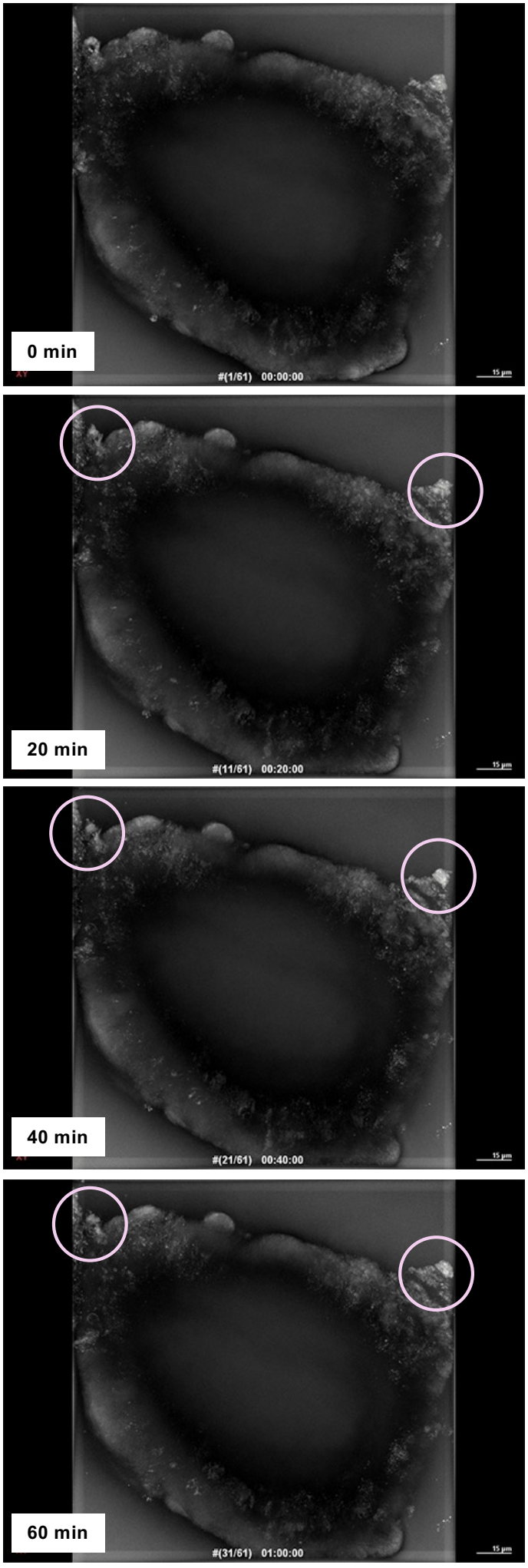


Supplementary Figure 6. Snapshots of No. 1 islet on Day 2 24° C during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. Purple circles indicate blebbing cells. The scale bar represents 15 μm.

Supplementary Figure 7

Day 2 24℃ , Islet #2

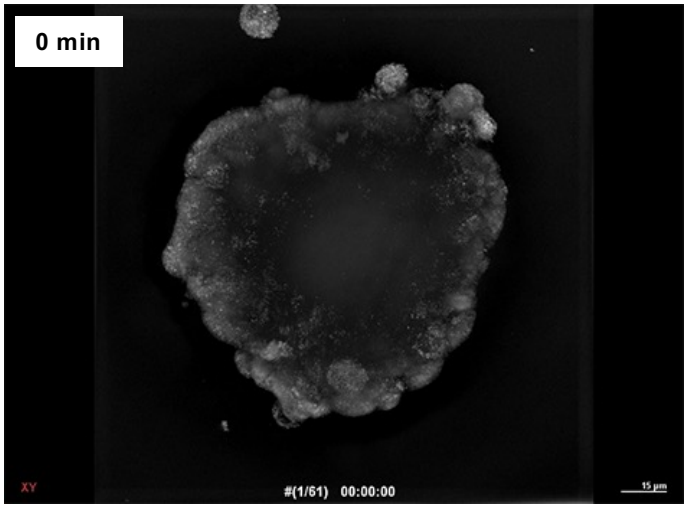


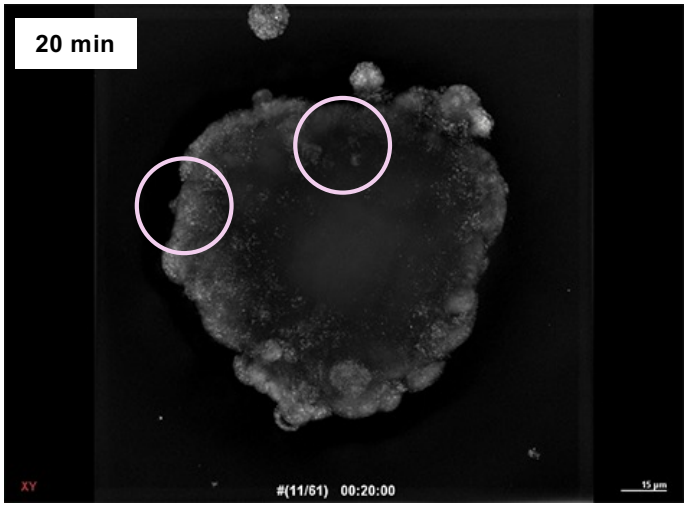
Supplementary Figure 7. Snapshots of No. 2 islet on Day 2 24° C during holotomographic time-lapse imaging.

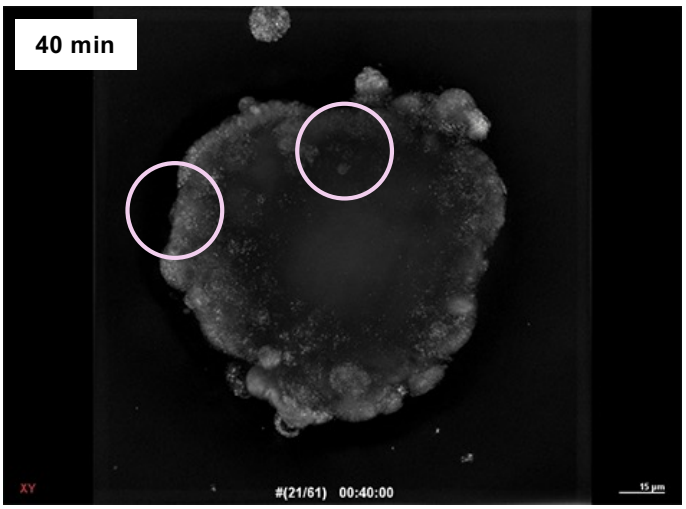
Images were captured at 2-min intervals. Purple circles indicate blebbing cells. The scale bar represents 15 μm.

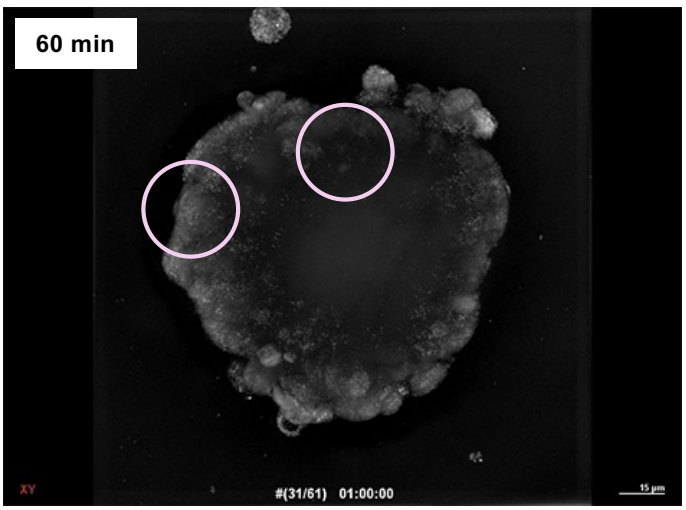
Supplementary Figure 8

Day 2 24℃ , Islet #3







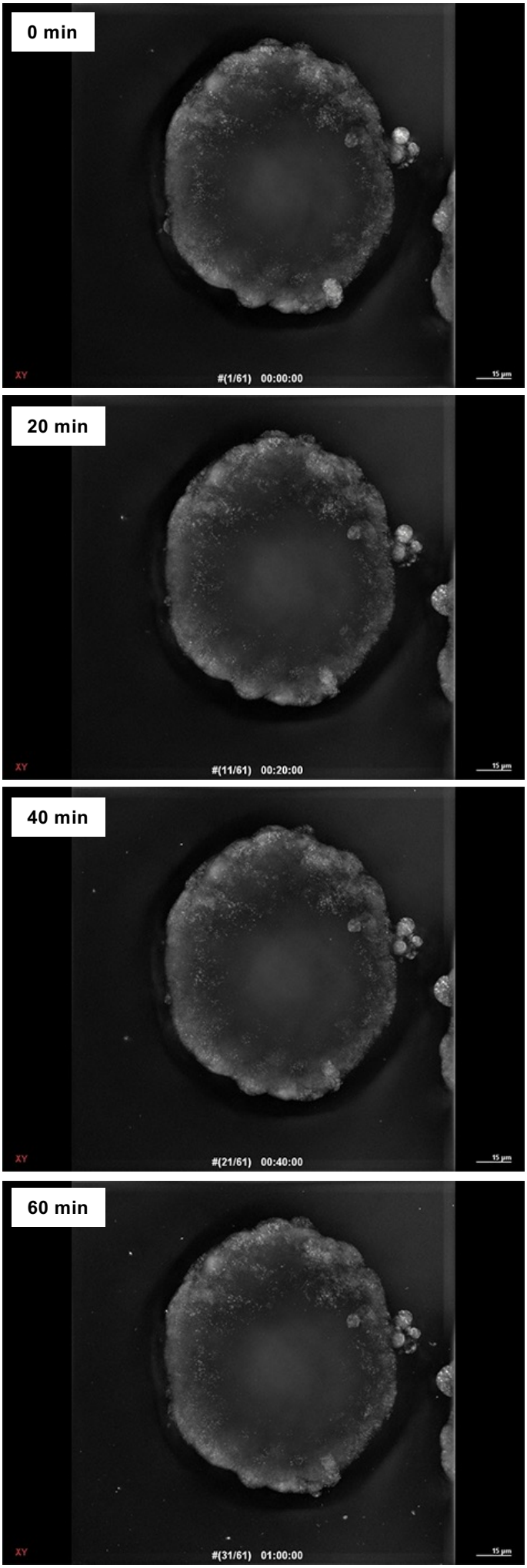


Supplementary Figure 8. Snapshots of No. 3 islet on Day 2 24° C during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. Purple circles indicate blebbing cells. The scale bar represents 15 μm.

Supplementary Figure 9

Day 2 24℃ , Islet #4

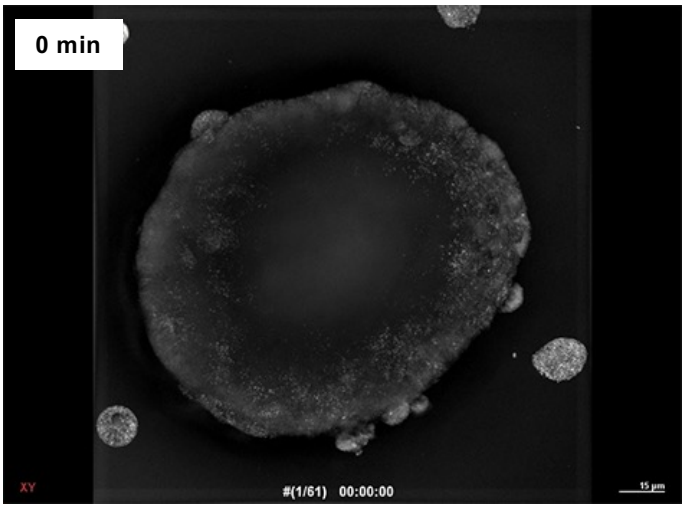


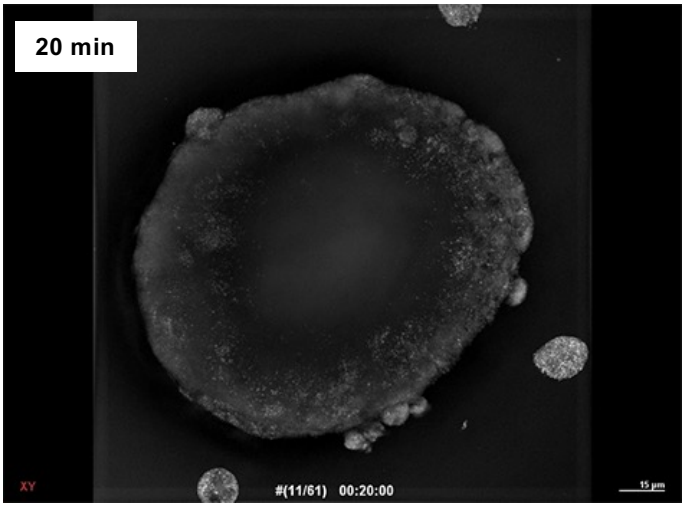
Supplementary Figure 9. Snapshots of No. 4 islet on Day 2 24° C during holotomographic time-lapse imaging.

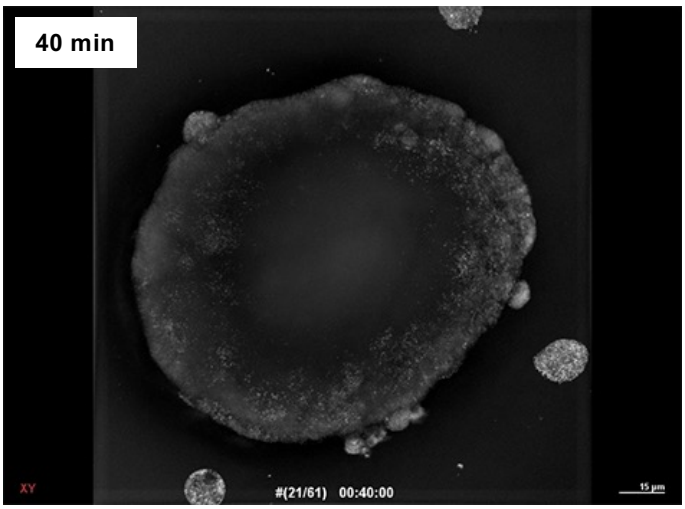
Images were captured at 2-min intervals. The scale bar represents 15 μm.

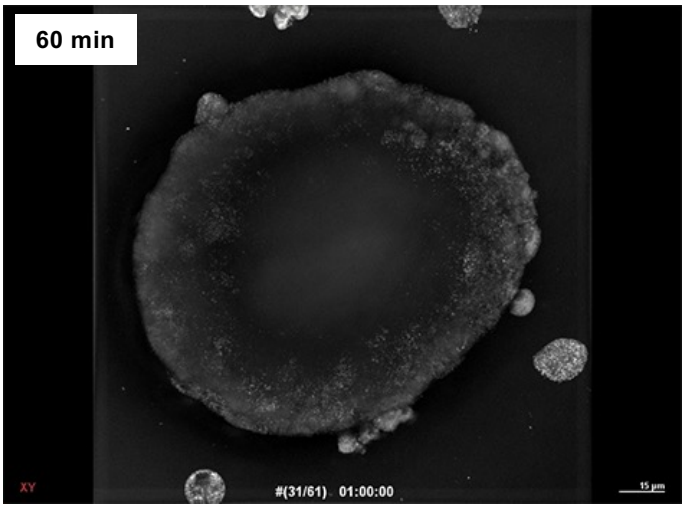
Supplementary Figure 10

Day 2 24℃ , Islet #5





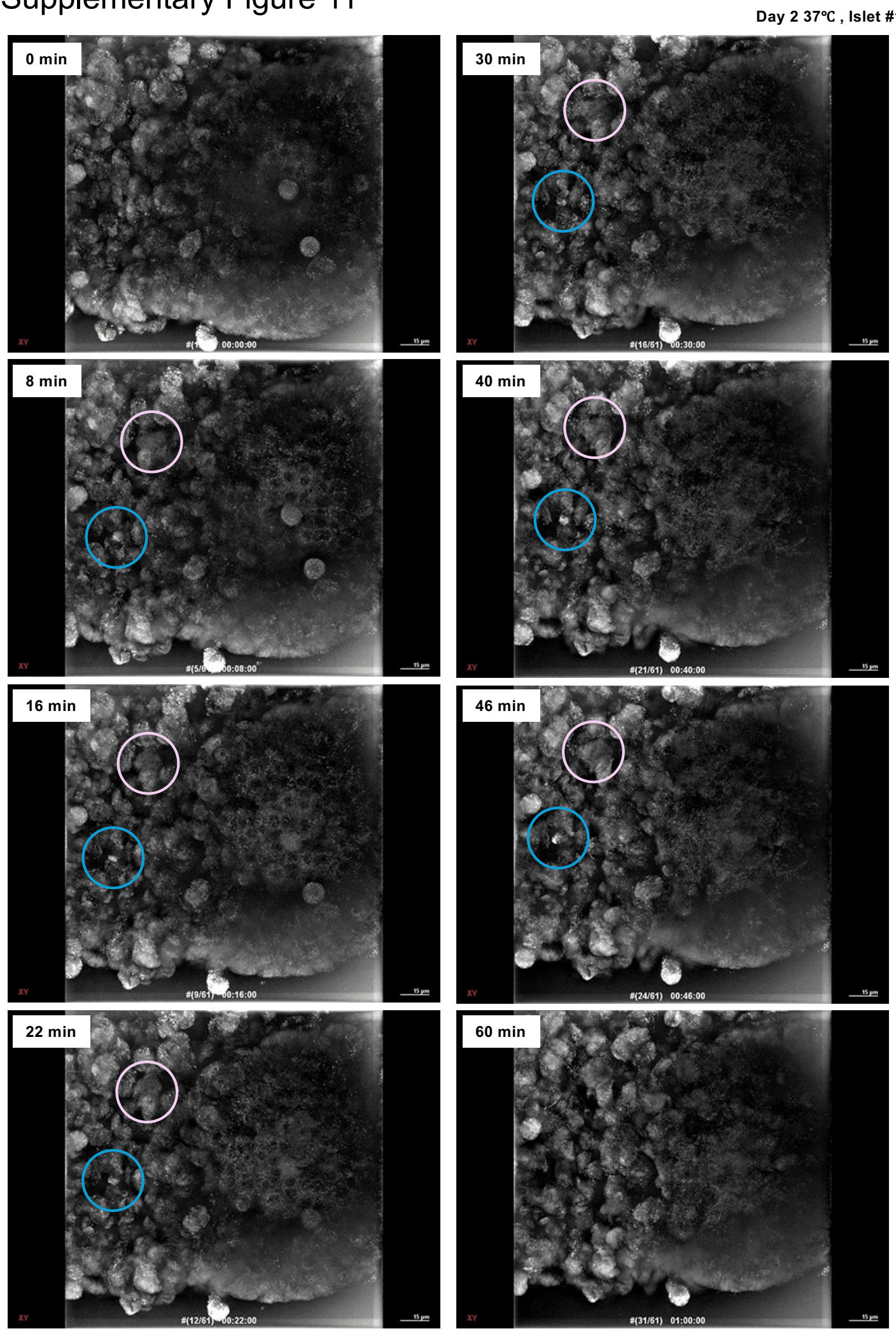




Supplementary Figure 10. Snapshots of No. 5 islet on Day 2 24° C during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. The scale bar represents 15 μm.

Supplementary Figure 11

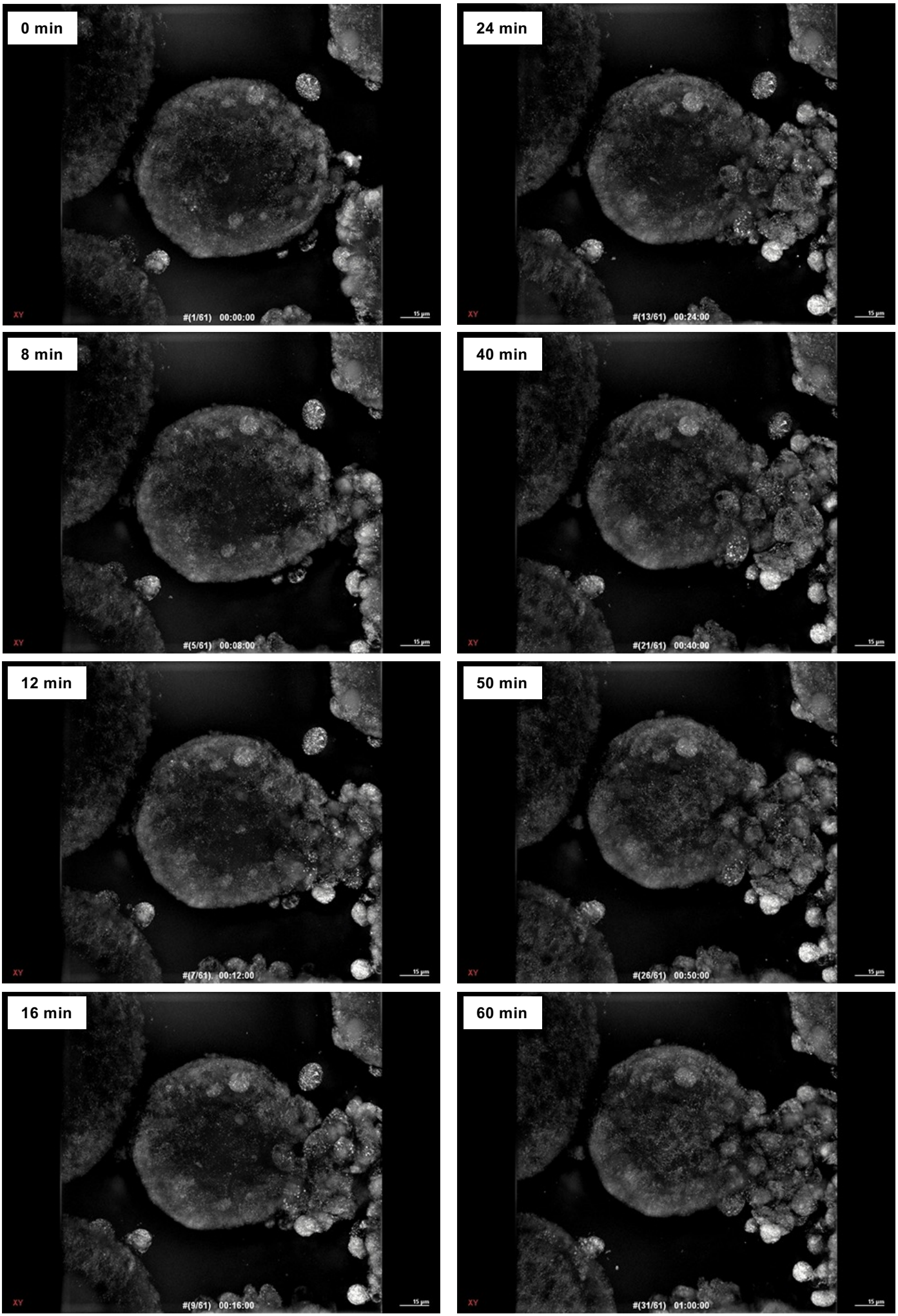


Supplementary Figure 11. Snapshots of No. 1 islet on Day 2 37° C during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. Blue circles indicate a nuclear- or nuclear-remnant-like structure, and purple circles indicate a blebbing cell. The scale bar represents 15 μm.

Supplementary Figure 12

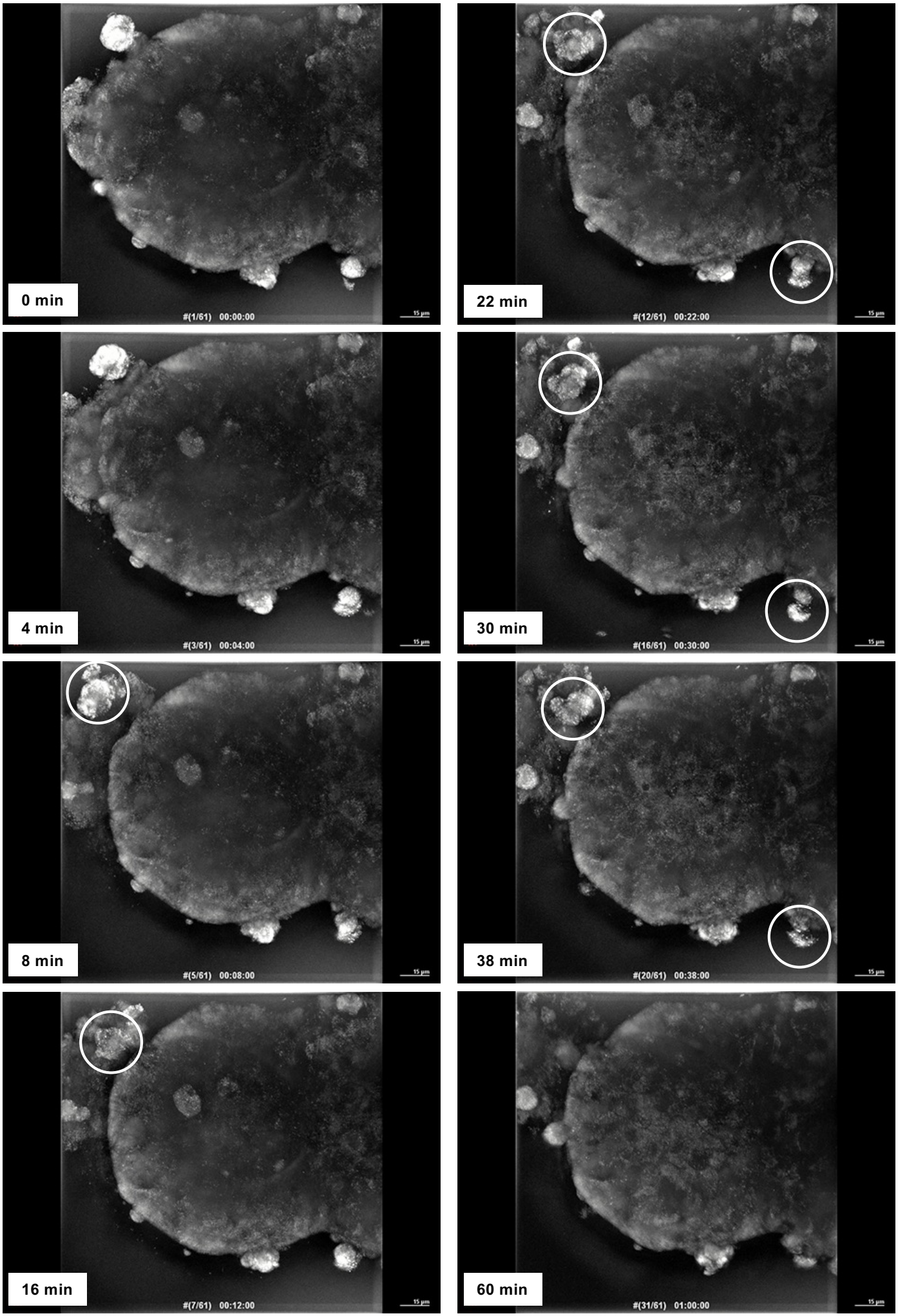
Day 2 37℃ , Islet #2



Supplementary Figure 12. Snapshots of No. 2 islet on Day 2 37° C during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. The scale bar represents 15 μm.

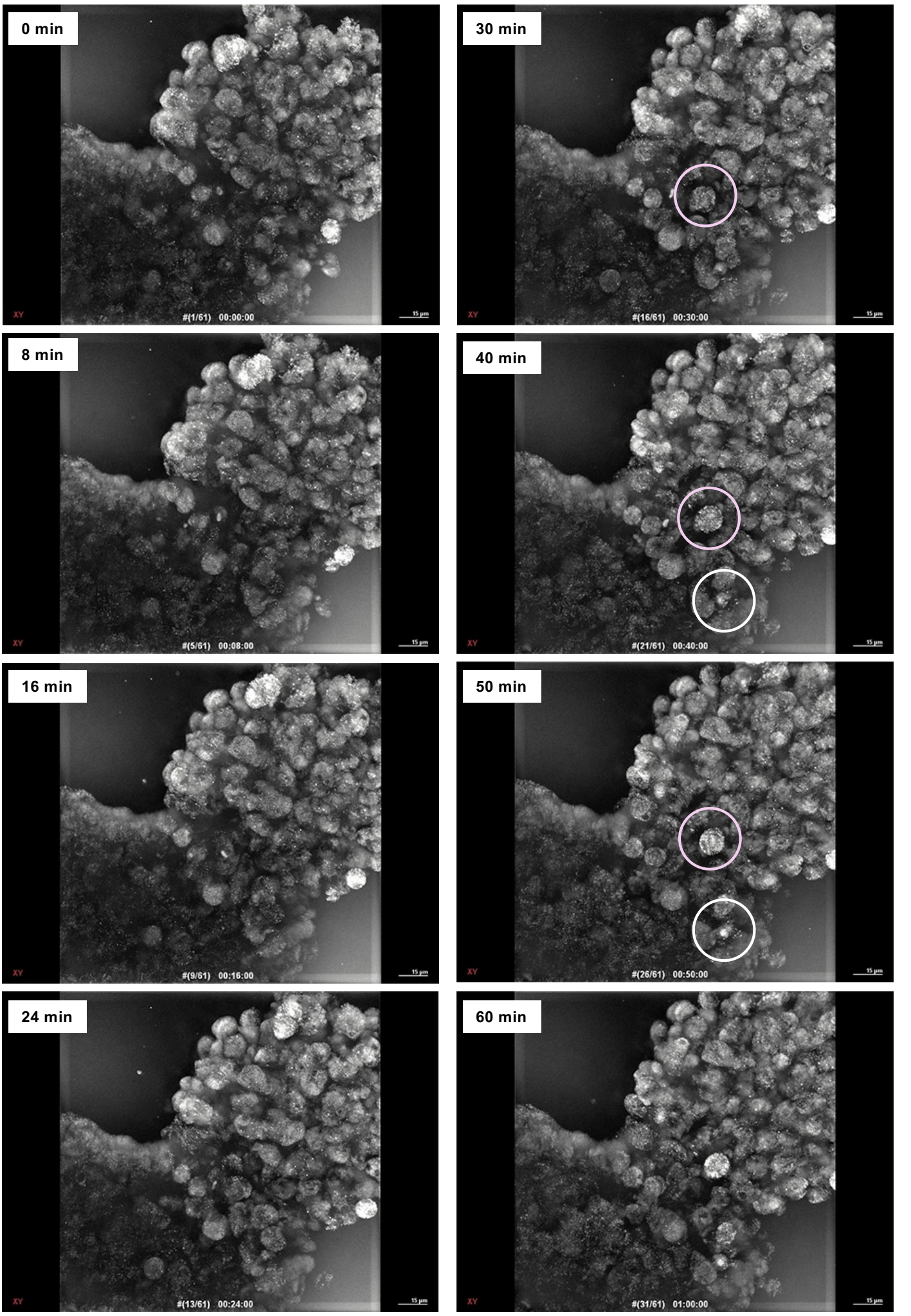
Supplementary Figure 13



Supplementary Figure 13. Snapshots of No. 3 islet on Day 2 37° C during holotomographic time-lapse imaging.

Images were captured at 2-min intervals. White circles indicate ruptured cell. The scale bar represents 15 μm.

Supplementary Figure 14

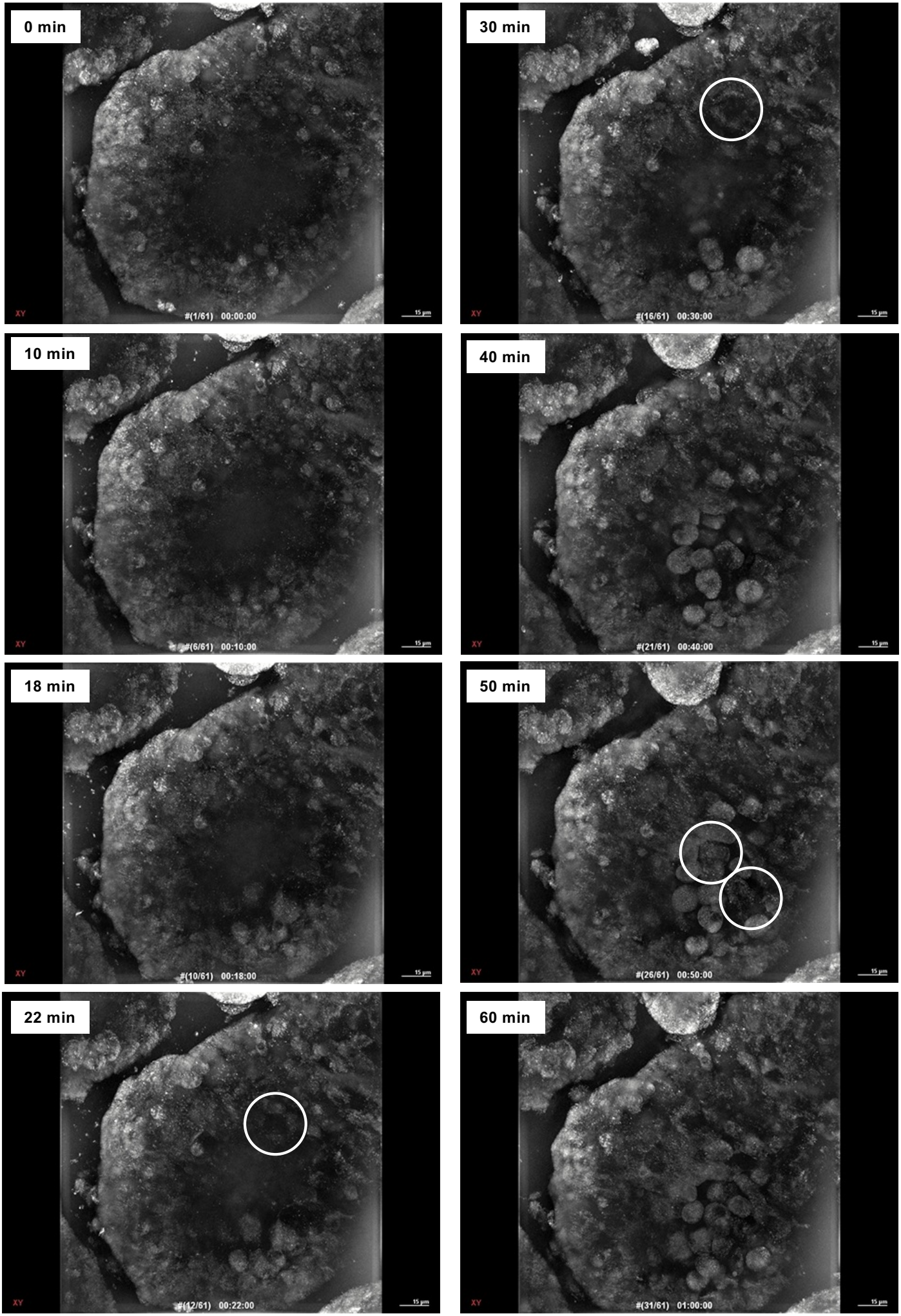


Supplementary Figure 14. Snapshots of No. 4 islet on Day 2 37° C during holotomographic time-lapse imaging.

All images were captured at 2-min intervals. White circles indicate a ruptured cell, and purple circles indicate a blebbing cell. The scale bar represents 15 μm.

Supplementary Figure 15

Day 2 37℃ , Islet #5



Supplementary Figure 15. Snapshots of No. 5 islet on Day 2 37° C during holotomographic time-lapse imaging.

All images were captured at 2-min intervals. White circles indicate ruptured cell. The scale bar represents 15 μm.

Supplementary Video 1. Holotomographic time-lapse images of No. 2 islet on Day 0.

Supplementary Video 2. Holotomographic time-lapse images of No. 4 islet on Day 2 24° C.

Supplementary Video 3. Holotomographic time-lapse images of No. 2 islet on Day 2 37° C.

Supplementary Table 1. Mouse primers for PCR

Primer name	Sequence (5′–3′)	T_m (°C)
Actb_F	CTGTCGAGTCGCGTCCA	59.05
Actb_R	ACGATGGAGGGGAATACAGC	59.24
Ins2_F	CACCAGCCCTAAGTGATCCG	60.18
Ins2_R	GCCATGTTGAAACAATAACCTGGA	60.02
Gcg_F	GCCCTTCAAGACACAGAGGA	59.31
Gcg_R	GGTGTTCATCAACCACTGCAC	60.00
Sst_F	CAGGTACCCAACTGAGTGTGA	59.31
Sst_R	ACCAGTGCTTTTACGCACCA	60.46
Pdx1_F	CCTTTCCCGAATGGAACCGA	60.04
Pdx1_R	TTCCGCTGTGTAAGCACCTC	60.32
Mafa_F	AAGCCGAGGAACTTACCTGC	60.04
Mafa_R	TAGAGAAATAGCAGCGCGGG	59.97
Nkx6-1_F	GTCGGACGCCCATCTTCTG	59.86
Nkx6-1_R	CAGAGAACGTGGGTCTGGTG	60.23
Cdh1_F	CAGCCGGTCTTTGAGGGATT	60.04
Cdh1_R	TGACGATGGTGTAGGCGATG	59.90
Itgb1_F	TCGATCCTGTGACCCATTGC	60.11
Itgb1_R	AACAATTCCAGCAACCACGC	59.97
Gjd2_F	CGGTACTGCCCAGTCTTTGT	59.97
Gjd2_R	CACCGTCTCCCCTACAATGG	59.82

Supplementary Table 2. Statistical Analysis for blood glucose

Effect	F value	Numerator degrees of freedom	Denominator degrees of freedom	P value
Group	5.1459	1	21	0.0340
Time	9.6941	10	12	0.0003
Group × Time	7.6482	10	12	0.0008

Supplementary Table 3. Statistical Analysis for plasma insulin

Effect	F value	Numerator degrees of freedom	Denominator degrees of freedom	P value
Group	0.8220	1	21	0.3749
Time	4.8157	4	18	0.0081
Group × Time	1.9722	4	18	0.1421

Supplementary Table 4. Statistical Analysis for blood glucose in glucose tolerance test

Effect	F value	Numerator degrees of freedom	Denominator degrees of freedom	P value
Group	6.0557	1	21	0.0226
Time	352.5411	4	18	<0.0001
Group × Time	1.7299	4	18	0.1873

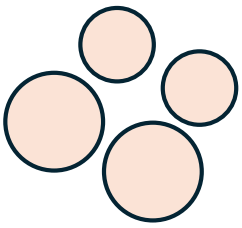
Supplementary Table 5. Statistical Analysis for residual rate of cultured islets

Effect	F value	Numerator degrees of freedom	Denominator degrees of freedom	P value
Group	18.0625	1	4	0.0132
Time	4.0625	4	1	0.3542
Group × Time	4.0625	4	1	0.3542

Label-free holotomography reveals dynamic structural remodeling in living pancreatic islets

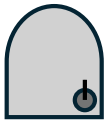
1. Study design

Morphological assessment performed to murine islets in…

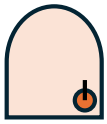


Day 0
Day 2 24℃
Day 2 37℃

Morphological assessment using…



Labe-free holotomography

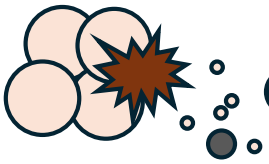


Bright-field microscopy

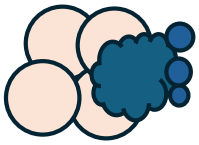
2. Holotomographic findings

1) Day 0

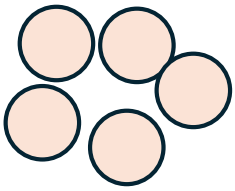
Membrane rupture



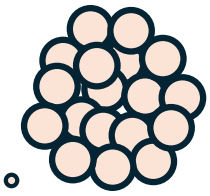
Apoptotic blebbing



Intercellular junction dissociation

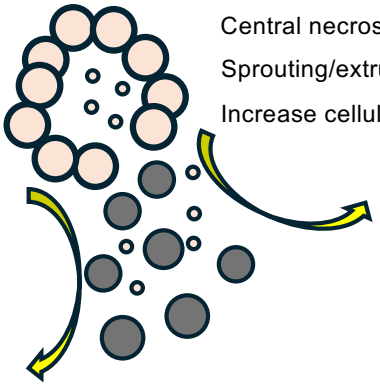


2) Day 2 24℃



Stable morphology
Robust intercellular junction
Few central necrosis
Few apoptosis

3) Day 2 37℃



Central necrosis remodeling
Sprouting/extrusion
Increase cellular death

3. Conclusion

Label-free holotomography visualizes dynamic, spatially organized morphological changes in living pancreatic islets.